Cenozoic radiolaria from European Platform: a review

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ABSTRACT
Stratigraphic correlations between western and eastern European areas under a clear boreal influence are difficult because different paleogeographic domains (boreal *vs* tropical) are involved in eastern countries and most of the boreal data which were acquired in eastern countries used technical equipment and methodologies which are not the same as in western countries, and also the Russian literature is not easily accessible, is usually in cyrillic and frequently lacks good illustrations.
From a review of Cenozoic Peri-Tethyan radiolarian investigations, it has become clear that there are problems with respect to correlate western and Russian studies, namely: Russian geographical and geological terminology, which is difficult for foreign scientists to understand; differing approaches to the establishment of a biozonation and hence to correlations; and species determination (and systematics) which were made, in some cases, on the basis of thin sections, or badly preserved fauna. In this article we give an explanation of some Russian geographical and geological terms. Information about the age, precise locality (with latitude and longitude) of Cenozoic deposits discovered in sections and wells of the Peri-Tethys basin along with a brief lithology, stratigraphy and biostratigraphy, based on micro and macrofauna investigations, for different regions, is presented in tabular form. And all palaeoenvironmental information is shown on the maps. The goal of this paper is to correlate various biological timescales from western to easternmost Europe with emphasis on data collection from eastern Europe.

KEY WORDS
radiolarians,
Peri-Tethys,
Cenozoic,
silica,
review.

Stratigraphic correlation of Upper Palaeozoic through Recent high latitude rocks has been hampered by a lack of world-wide cooperative studies. Now that scientific exchange is easier between Eastern and Western workers, a rapid solution of many stratigraphic problems may be achieved through joint projects. Before starting on this detailed comparison of eastern and western studies we here present a review of previous works.

RÉSUMÉ

Les corrélations stratigraphiques entre les régions d'Europe occidentale et orientale sous influence boréale franche sont difficiles car différents domaines paléogéographiques (boréal *vs* tropical) sont généralement intriqués dans les pays de l'Est et la plupart des données boréales acquises dans les pays de l'Est le furent avec des moyens techniques et des méthodes différents de ceux des pays occidentaux, en outre la littérature russe n'est pas aisément accessible, est écrite en caractères cyrilliques et manque généralement d'illustrations de qualité.

À partir d'une revue des travaux effectués sur les radiolaires cénozoïques de la Péri-Téthys, il est devenu évident que des problèmes majeurs de corrélations se posaient pour plusieurs raisons. Tout d'abord à cause d'aspects géographiques et terminologiques qui sont parfois difficiles à appréhender pour des scientifiques étrangers. Ensuite parce que les approches diffèrent dans l'établissement des biozonations et des corrélations. Les acceptions varient aussi pour les déterminations spécifiques (et donc aussi systématiques) qui furent d'ailleurs effectuées, dans de nombreux cas, à partir de plaques minces, ou de faunes mal conservées. Dans le présent article nous donnons une explication de quelques noms géographiques ou termes géologiques. Nous présentons aussi sous forme de tableaux et de cartes des informations à propos des âges, précisons les localisations (en latitude et longitude) de dépôts Cénozoïques trouvés sur des coupes ou en forage et appartenant aux bassins Péri-Téthysiens, accompagnés d'une brève description lithologique, du cadre stratigraphique et paléoenvironnemental, fondés sur les micro- et macrofaunes, pour les différentes régions. L'objectif de cet article est de pouvoir corréler diverses échelles biologiques d'Europe occidentale avec les plus orientales en mettant l'accent sur les données d'Europe orientale.

Les corrélations stratigraphiques du Paléozoïque Supérieur au Récent dans les roches de hautes paléolatitudes ont été freinées par un manque de coopération largement internationale. Maintenant que les échanges scientifiques sont plus faciles entre pays de l'Est et de l'Ouest, une solution à divers problèmes stratigraphiques devrait pouvoir être obtenue rapidement par des projets conjoints. Avant de commencer cette étude détaillée entre stratigraphies occidentale et orientale, nous présentons une revue des travaux antérieurs.

MOTS CLÉS
radiolaires,
Péri-Téthys,
Cénozoïque,
silice,
revue.

INTRODUCTION

For both the upstream and downstream side of several studies it is necessary to homogenize different biological chronometers. The goal of this paper is to consolidate information so that geologists interested in basinal deposits can quickly and easily use the interrelationship of microfossils as a useful tool. Our goal is to correlate, using modern methods, various biological timescales from western to easternmost Europe with emphasis on data collection from Eastern Europe.

Most studies in micropalaeontology in the former Soviet Union developed without the knowledge of the western literature and, to some extent, the reverse was also the case which arose a problem of consanguinity.

Some fossil groups have been studied for a long time and are relatively well known. Correlation between several basins using these fossil groups is possible, even though still imperfect. Planktic organisms have been shown to be more useful than benthics. On the contrary, some other groups, such as radiolarians, have been largely ignored.
Microfossils are important, but some groups are often overlooked as **stratigraphic tools**. Their usefulness for quick analysis in Palaeozoic to Eocene rocks is excellent if certain systematic conformity can be agreed upon. The changing relationships between microfossils groups (diatoms, foraminifers, radiolarians, conodonts, sponge spicules, and nannofossils) may signal changes in basin and oceanographic conditions.
Stratigraphic correlations with eastern European areas under a clear boreal influence are difficult because: (1) different paleogeographic domains (boreal *vs* tropical) are involved; (2) most of the boreal data has been acquired in eastern countries where technical equipment and used methodologies are not the same as in western countries (use of a scanning electron microscope is still uncommon in several countries); (3) the Russian literature is not easily accessible, is usually in cyrillic and frequently lacks good illustrations.
The long term objective of our study is to:
1. Re-examine the taxonomy of radiolarians from western intracratonic basins and from the Russian Platform, Caspian Sea Region, Siberian Lowlands, North Kazakhstan.
2. Set up a biostratigraphy of these organisms (quantitative biochronology) with the same means as that used for the recent Tethyan synthesis (Baumgartner *et al.* 1995).
The present paper represents the first part of this final objective.

From a review of Cenozoic Peri-Tethyan radiolarian investigations, it has become clear that there are problems with respect to correlate western and Russian studies, namely: (1) Russian geographical and geological terminology, which is difficult for foreign scientists to understand; (2) differing approaches to the establishment of a biozonation and hence to correlations; (3) species determination (and systematics) which were made, in some cases, on the basis of thin sections (Chediya 1973), or badly preserved fauna (Subbotina 1960). In this article we give an explanation of some Russian geographical and geological terms. Information about the age, precise locality (with latitude and longitude) of Cenozoic deposits discovered in sections and wells of the Peri-Tethys basin along with a brief lithology, stratigraphy and biostratigraphy, based on micro- and macrofauna investigations, for different regions, is presented in tabular form (Table 2) and all palaeoenvironmental information is shown on the maps (Figs 6-14).

Future studies will provide:
– Lithologic descriptions of some key sections and cores that are representative of some regions or basins with their precise locations (latitude and longitude).
– Microfossil database. A complete computerized database (with taxonomy, photos, geographic occurrences, etc.) is being developed.

Other indirect benefits:
– Opportunity to develop closer relationships between scientists and to have easier access to local literature.
– Understand terminologies in translation such as those referring to lithologies (domanikoids facies, opoka, aleurolites, menilites) or geography (Preduralie *vs* Cis-Ural, Zauralie *vs* Trans-Ural, Predmugodzharie *vs* Cis-Mudjarie, Pri- = nearby, ex. Pripolar...)

Stratigraphic correlation of Upper Palaeozoic through Recent high latitude rocks has been hampered by a lack of world-wide cooperative studies. The reasons include a global political climate that hampered technology transfer between countries and scientists. Now that scientific exchange is easier between Eastern and Western workers, a rapid solution of many stratigraphic problems may be achieved through joint projects. Sample and technology exchange will help researchers to see a more complete fossil record and better networking can now allow interested workers to develop models that will help to interpret geologic basins. Before starting on this detailed comparison of eastern and western studies we will present a review of previous works.

HISTORY OF STUDY ON RADIOLARIANS

A good review of this topic has been published by Sanfilippo *et al.* (1985a). Parts of it are quoted in the present text.

For a long time (and one can still find it in some handbooks) radiolarians have been regarded as being of little use for stratigraphy. For example, Shrock & Twenhofel (1953: 67) indicated that "fossil Radiolaria ... have not been found useful for age determination or correlation, partly because of the fact that fossil species are much like existing ones, and partly because so few forms have been found." More recently one can find: "*Ce sont de mauvais fossiles ayant peu varié depuis le Primaire jusqu'à l'Actuel*" (Encyclopedia Universalis 1980: 1065b). This reveals how *idées reçues* have longevity.

In 1950, the reasons for considering radiolarians to be useless as a stratigraphic tool seemed obvious. All the literature of the previous years supported the idea that the families and genera of radiolarians in Palaeozoic rocks are the same as those in present-day plankton (Campbell 1954). Even at the level of species, many forms in "Recent" sediments collected from the ocean floor by the *Challenger* expedition were seen to be the same as those occurring in Early Tertiary sediments on Barbados (Haeckel 1887). A chalk from the island of Rotti, near Timor, dated as Pliocene, contained a radiolarian assemblage showing greater similarities to Mesozoic faunas of Europe than to Late Tertiary assemblages and present-day plankton (Tan 1927, 1931).

Pessimism concerning the inutility of radiolarians for stratigraphic purposes was erradicated by the work of Riedel (1952, 1953). Material obtained from oceanographic cruises, such as the Swedish *Deep-Sea* Expedition of 1947-1948, provided the key to understand the utility of radiolarians for stratigraphy. The lower parts of several piston cores from the tropical Pacific were found to contain radiolarian assemblages similar to those that had been described from the Early Tertiary of Barbados, or the Late Tertiary of Italy and California. The radiolarian assemblages of the upper parts of all the cores in the region contained a constant component, comprising species described from present-day plankton, and many contained as well a part that varied from core to core, but could be matched with one or more of the Tertiary assemblages that had been encountered a few metres below the sediment surface. Evidently, the rates of accumulation of pelagic sediments were sufficiently low, and physical disturbances of bottom sediments were sufficiently common and intense, to cause widespread admixture of Tertiary radiolarians with Recent ones at the sediment surface (Riedel 1952, 1957a). Therein lays the explanation for the large number of species in common between recent assemblages, and those in Tertiary rocks. In fact the radiolarians at different levels in the Tertiary were sufficiently different to permit their application in biostratigraphy. Therefore, the "Mesozoic aspect" of the "Pliocene" assemblage from Rotti became increasingly odd. Re-examination by Riedel of the samples involved led to the solution: the *Dutch* expedition had collected samples of pelagic chalks of two different ages. The samples containing the rich radiolarian assemblages can be dated as Cretaceous on the basis of their calcareous nannofossils, and the samples containing Pliocene nannofossils have a sparse radiolarian fauna that had not been noticed before.

The development of the knowledge of stratigraphic utility of radiolarians has been recent and rapid. Now there are about a hundred paleontologists (academic and industrial) whose principal involvement is radiolarian stratigraphy.

Initial studies of radiolarian biostratigraphy were established generally on similarity at the level of species, and did not contradict the fixed conviction that most genera and families had persisted from the Palaeozoic to the Recent. However, with the Deep Sea Drilling Project, which has been coring long columns of pelagic sediments in all major oceans since 1968, a better knowledge of stratigraphic ranges of radiolarian species was obtained, and as ancestor-descendant relations were demonstrated, it became obvious that the lengthy stratigraphic ranges of genera were unnatural.

FROM PLANKTON TO SEDIMENTARY ROCKS

Radiolarians, a class of actinopods, are marine protozoa with a capsular membrane which separates an ectoplasm from an endoplasm. Polycystines (a Superorder), with their siliceous skeletons, are the only radiolarians *s.l.* which are preserved as fossils. At present, among Polycystines, members of the order Nassellaria are the most diversified, but Spumellarians seem to be the most abundant (Lombari & Bowden 1982). The skeleton is included within the cytoplasm, out of contact with sea water and, therefore, is not exposed to dissolution during the cell's life. Several groups have a high content of endoplasmic oil-droplets and could represent a primary source of hydrocarbons.
Radiolarians may exist from the poles to the equator, but their abundance varies. Like other planktonic organisms, their abundance is more dependent upon the supply of nutrients than on the silica supply. Most of them live in the upper few hundred metres of the water column in all oceans and seas of normal marine salinity. Their diversity and numbers of individuals decline in near-shore waters. In high latitudes the number of species (diversity) is much smaller than in low latitudes, even if the number of specimen (abundance) is high. A latitudinal distribution does exist for radiolarian associations. It is also possible to differentiate surface from subsurface assemblages.

After death, an individual test is at least partially dissolved during settling and while it lies exposed on the bottom of the ocean. According to Schrader (1971), Dunbar & Berger (1981), Asper *et al.* (1992), the settlement of microplankton occurs in faecal pellets. But there were not much radiolarians records which have been find in them but around them (Nakaseko *et al.* 1985). Chemical and physical characteristics of tests vary according to taxa (King 1975, 1977) as does the dissolution affecting them (Riedel 1958; Renz 1976; Bjørklund & Goll 1986; Swanberg & Bjørklund 1992). Because of the ubiquity of radiolarians in plankton, and the fact that the preservation of their skeletons is not controlled by a compensation depth analogous to that for calcium carbonate, one might expect to find them more commonly in present-day and ancient sediments, than is actually the case.

The numbers of individuals and species are lower in sediment (and *a fortiori* in the rock) than in plankton. Radiolarians may be abundant in relatively shallow basins close to a shoreline, *e.g.* the Santa Barbara Basin, off California under a depth of 500 m (Kling 1979) and the Norwegian fjords (Swanberg & Bjørklund 1992). In all these regions, radiolarians are accompanied by (and in the polar regions markedly dominated by) diatoms. If, at certain localities in these regions, radiolarians are not a prominent component of the sediments, it is usually a result of their dilution by other constituents, and not of their dissolution.

In oceanic recent sediments (Miocene-Present), the radiolarian abundance on a site is connected either to high or low stands (*e.g.* South Atlantic coast off Africa, Walvis Ridge; Diester-Haass *et al.* 1992; Hay & Brock 1992).
Less than 1% of the silica fixed by planktonic organisms in surface waters is preserved within the geological record. Silica phase transformations are accompanied by porosity reduction. The original porosity is higher when the sediment is richer in silica and during diagenesis (Isaacs 1981). For the geologist, the porosity decrease (volume) corresponds to a diminishing of the thickness and he has to take into account the important decompacting factor when making accumulation rate and palaeoproductivity calculations (De Wever *et al.* 1994).
In addition to pressure and temperature, time favours both opal transformations. Thus cherts are more prevalent in older sediments (Palaeozoic and Mesozoic) and porcelanites in more recent ones (Cenozoic). The transformation opal-A to opal-CT is estimated to occur at 25-50° and

takes 20 Ma in areas of low to moderate sedimentation rates and 5-10 Ma in areas of high sedimentation rates (Kastner 1981). The opal-CT to quartz transformation occurs within 40-50 Ma (Keene 1976).

STRATIGRAPHY

Because of the difficulty to extract radiolarians from siliceous rocks, the first zonations were proposed for the Cenozoic only during the late 1970's.

Some of the most fundamental step, that of recording the earliest or latest occurrence of a radiolarian taxon in a series of samples, is often complicated enough to constrain a part of subjective opinion. This applies to the limits of species defined morphotypically. Morphotypic limits are perforce used when phylogenetic relationships are unknown, and may also be used in addition to evolutionary limits, when lines of evolution are clear. Under some circumstances, evolutionary limits can be stratigraphically more useful than morphotypic ones. Such is the case when all members of a species change gradually to the descendant morphology, as in the species belonging to the genus *Diartus* (*D. pettersoni, D. hughesi*) or *Spongaster* (*S. tetras, S. pentas, S. berminghami*) (Johnson & Nigrini 1985a, b). That matter is complicated in some cases when an ancestral form persists to co-occur with a descendant lineage over some length of time (as *Pterocorys sabae* and *P. campanula* persist along with their ancestor *P. clausus* Caulet *et* Nigrini, 1988; or as *Clathrocyclas bicornis* persists along with its descendants *Cycladophora sphaerica* Popova, 1991 and *Cycladophora hayesi* Lazarus, 1988). These methods produce a list of stratigraphic events in each sequence, and the different succession of events are correlated. In most cases some of the correlation lines cross and it is necessary to choose which of the two conflicting pieces of evidence (crossing lines) is to be accepted. For this purpose, it is helpful to evaluate the level of reliability of each event, according to a number of criteria. It is worth noting that a diachronism must be invoked in some cases. This diachronism has been demonstrated between different oceans (Indian/Pacific), in the same ocean (western/eastern Indian and Pacific Oceans), as well as for a same phylogenetic transition (Johnson & Nigrini 1985a, b). In some cases this diachroneity reaches up to 10 Ma: as for *Acrosphaera murrayi* gr., or *Lithostrobus* cf. *L. hexagonalis* (Nigrini & Caulet 1992). In some special environments, such as upwelling systems, this diachroneity may be considerable: *Lamprocyclas hadros* appears more than 10 Ma ago off Oman, while it first occured at 6 Ma off Peru (Nigrini & Caulet 1992).

A succession of specific events provides the greatest stratigraphic resolution, but it is awkward to transmit information in this form to biostratigraphers working with other fossil groups, and particularly to general geologists. The message is simplified by separating the succession of events into clusters, each of which delimits a zone. Events used to define zones are usually selected on the basis of their existence reliably identifiable over wide geographic areas. Some specialists of several microfossil groups describe as many zones as are permitted by the number of events available to them. Such a procedure would be unrealistic for radiolarians, especially in the high-diversity areas of the tropical and temperate latitudes, and therefore only a practical number of radiolarian zones are defined there (ex. about thirty for the entire Cenozoic by Sanfilippo *et al.* 1985a).

Ongoing work, especially on material acquired during the Deep Sea Drilling Project and Ocean Drilling Program, provides a growing number of radiolarian events, and of sequences in which they are recognized. It has thus become impossible for any individual researcher to organize all of the results for determining what is the most likely stratigraphic order of events in each biogeographic province, and which variation requires interpretation in terms of environment, preservation, factors etc. To facilitate this task, one may use the method of probabilistic stratigraphy described by Hay (1972). The method involves an initial arrangement of the events in a best estimated stratigraphic order, and then inverting the above/below relations of pairs of adjacent events until the number of contradictions is the minimum. A major objection to this

AGE	Stage	Moderate deep water facies	Shallow water facies				
		Regional plaktonic foraminiferal zones	Nikitina 1972	Over zones	Zagorodnuk 1967	Characteristic and concomitant species	
			Foraminifera		(Radiolaria)	Foraminifera	Radiolaria
EOCENE	Al'minsky	*Bolivina antegressa* s.s	*Bolivina antegressa* *Lenticulina calcariformis*	*Lenticulina limbosa*	*Cenosphaera mariae*	*Cylindroclavulina rudilosta*, *Lenticulina simferopolica*, *Marginulina behmi*, *Brotzenella taurica taurica*, *B. praebinaensis crassa*, *Daniella neogranosa*, *Nonion curviseptis*, *Caucasina aziderensis*	*Cenosphaera mariae*, *Porodiscus turgaicus*, *Druppatractus santaennae*, *Cenosphaera mitgarzae*, *Spongodiscus concentricus*, *Caenosphaera valentinae*, *Phacodiscus tumefactus*, *Thecosphaera scabra* *Sethocyrtis minimus*, *Astrophacus* n.sp.
			Bolivina jacksonensis *Brozenella taurica taurica*			*Cyclammina pseudocancellata*, *Pseudoclavulina colomi*, *Marginylina infracompressa*, *Brotzenella taurica acutiformis*, *Uvigerina eocaena*	
	Bodraksky	*Globigeraspis tropicalis*	*Brozenella taurica acutiformis*	*Lenticulina miera*	*Spongasteriscus gorskii*	*Marginulinopsis fragarius*, *Plectofrondicularis sturiata*, *Bolivina jacksonensis*, *Bulimina sculptilis*	*Carposphaera usunensis*, *Stylodyctia tschjebkoi*, *Sethopyramis victori*, *Amphistylus ensiger*, *Thecorys humilis*, *Spongastericus gorskii*
		Globigerina turcmenica	*Spiroplectammina vicina morpha*		*Xiphatracus visendus*	*Haplophragmoides macer*, *Caucasina eocaenica*	*Xiphatracus visendus*, *Carposphaera usuensis*, *Sethopyramis victori*, *Spongastericus gorskii*, *Stylotrochus radiatus*, *Sethocyrtis parvissimus*, *Porodiscus annularius*
		Hantcenina alabamensis	*Brozenella kerestensis* *Pseudoclavulina subbotinae*	*Lenticulina dimorpha*	*Astrophacus duplus*: *Phacodiscus duplus*	*Lenticulina grodnensis*, *Anomalinoides postvulgaris*, *Brotzenella kerestenensis*	*Phacodiscus duplus*, *Conocaryomma aralensis* *Astrophacus duplus*, *A. testatus*, *Phacodiscus subsphaeriscus*, *Prunopyle ovata*
		Acarinina rotundimarginata	*Lenticulina kuberlina*		*Astrophacus duplus*: *Phacodiscus* sp.	*Hopkinsina bykovae*, *Eponides stellatus*, *Gemellides kasahstanicus*, *Pseudoclavulina listerelloides*, *Hantkennina liebusi*, *Bulimina praesculptilis*	*Astrophacus duplus*, *Phacodiscus subsphaeriscus*, *Conocaryomma aralensis*, *Lithomelissa* n.sp. *Rodesphaera* n.sp., *Sethocyrtis tamdiensis* n.ssp.
	Simferopolsky	*Acarinina bulbrooki*	*Brozenella postacuta aksuatica*	*Lenticulina subspanilosa* *S. carinatiformis*	*Podocyrtis prunoformis*	*Textularia tjuljussica*, *Lenticulina* ex.gr. *inomata*, *Truncorotalia aragonensis caucasica*	*Lychnocanium bellum*, *Carposphaera megapora* n.ssp. *Stylosphaera minima*, *Spongodiscus aralensis*, *Podocyrtis prunoformis*, *Lithatractus turgaicus*
		Truncorotalia aragonensis	*Anomalina scrobiculata*		*Cenosphaera pila*	*Ammobaculites midwayensis*, *Lenticulina ergenica*, *Acarinina pentacamerata*, *Hopkinsina compacta* *Bulimina mitgarziana*, *Brotzenella postacuta postacuta*	*Cenosphaera pila*, *Carposphaera microporulosa*, *Thecosphaera* n.sp., *Cromyodruppa tebesensis*, *Ellipsostylus inclaris*, *Amphibrachium gracilis*, *A. planum*, *Amphicaridiscus fusoides*, *Histiastrum paleogenus*, *Stethostylus acutus*
	Bakhchisaraisky	*Globorotalia subbotinae*	*Lenticulina mexicana nudicostata*	*S. terena* *B. postacuta postacuta*	*Amphicarydiscus fusoides*	*Marginulina eofragarius*, *Lenticulina vialovi*	
		Globorotalia aequa	*Lenticulina mexicana praemexicana*			*Gratus lybicus*, *Cidicidoides textilis*, *Gaudryina navarroana*	

FIG. 1. — Correlation between regional zones based on planktonic foraminifers and radiolarian zones on Russian platform (according to Zagorodnyuk 1969).

method is that no plan exists for taking into account the disparity of reliability, between recorded data: state of preservation, type of bioevent, geographic extension of an event...

Differing from oceanic data, land-based collections of data are frequently isolated, scattered stratigraphically and geographically and the difficulty there lays in establishing correlation between events in spaced sequences. When information is scarce and scarce to such a point that correlation is impossible or at least delicate, such as in the Mesozoic, some workers use another method described as Unitary Associations (Guex 1987, 1991).

Diachroneity is one of the primary factors limiting biostratigraphic correlations. Independent regional calibration of biostratigraphic event thus offers the possibility of significantly improved age models. Regional calibration of zonations is also needed for biostratigraphic events that are endemic to the region. It has long been recognized that radiolarian biogeography, perhaps more than any other microfossil group, differs between low and high latitudes, with many endemic species occurring within the latitudinally arranged biogeographic provinces of the ocean. Radiolarian stratigraphy in the Cenozoic reflects this distinctive biogeographic pattern, with separate zonation schemes for the tropics (Sanfilippo *et al.* 1985a; Johnson *et al.* 1987), Antarctic (Caulet 1991; Lazarus 1992) and Norwegian-Greenland sea (Goll & Bjørklund 1989).

SUMMARY OF STUDIES

The most abundant and used data have been obtained from the oceans. In order to position land-based studies relative to oceanic ones we will begin with a short summary of oceanic studies contributing to our understanding of radiolarian occurrences through the Cenozoic. The most important source of information on the occurrences and distribution of Cenozoic radiolarians is the series of Initial Reports of the Deep Sea Drilling Project and Ocean Drilling Program.

A compilation of papers in that series, dealing with Cenozoic radiolarians is provided by Premoli Silva *et al.* (1976), for Legs 1-39, by Sanfilippo *et al.* (1985a) for subsequent legs, and more recently by Spencer-Cervato *et al.* (1993) for the North Pacific Ocean.

ACQUISITIONS FROM OCEANS

Most of the recent studies on Cenozoic radiolarian stratigraphy have been on samples from tropical and temperate latitudes, but the first radiolarian zones were defined from the Antarctic (Hays 1965). High-latitude radiolarian assemblages contain only 10% of the number of species found in low-latitudes assemblages, and their most obvious constituents are species that are absent or rare in low latitudes. This implies that radiolarian zonation established for high latitudes differ from that applied in low latitudes. Progress to solve this problem are expected from investigation of mid-latitude "sub-boreal" samples which contain elements of both cool- and warm-water assemblages, and particularly from regions such as the southern Russian platform.

Late Miocene - Recent

Neogene radiolarian sediments have been reported off north-west Africa, California and Central America (Lancelot, Seibold *et al.* 1978; von Rad, Ryan *et al.* 1979; Lancelot, Winterer *et al.* 1980; Rosendahl, Hekinian *et al.* 1980; Yeats, Haq *et al.* 1981; Watkins, Moore *et al.* 1982...).

In Recent sediments Goll (1976a) has shown that radiolarians are widespread in the Pacific and Indian Oceans (except beneath the central water masses), and are restricted to high southern and northern latitudes, and off West Africa in the Atlantic Ocean. The biogeographic distribution of distinct assemblages throughout the Pacific and Indian Oceans is described by Sancetta (1978), and for the Pacific by Casey (1971a, b) and by Moore (1978). More restricted biogeographic investigations of the tropical Pacific have been published by Nigrini (1968) and by Johnson & Knoll (1974), and North Pacific distributions are described by Nigrini (1970), Sachs (1973) and Kruglikova (1977). Studies of radiolarians from particular regions are listed on table 1.

In addition to numerous contributions of the Deep Sea Drilling Project, the stratigraphy of late

Neogene radiolarians in the tropical Pacific is described by several authors (Table 1).

The distribution of radiolarian sediments in the Indian Ocean is considered in some detail by Caulet (1978, 1991) and Nigrini (1991). Biogeographic investigations have been made in the Indian Ocean sector of the Antarctic by Petrushevskaya (1967), and in lower latitudes by Nigrini (1967), Petrushevskaya (1972a, b), Johnson & Nigrini (1980, 1982) and Johnson *et al.* (1987). Late Neogene Indian Ocean radiolarian stratigraphy in high latitudes has been described by Hays (1965) and Keany (1979), and in lower latitudes by Caulet (1979).

The general distribution of Recent radiolarian sediments in the Atlantic Ocean is described by Goll & Bjørklund (1971(2), 1974). Biogeographic investigations have been made for the South Atlantic (Morley 1979), the eastern tropical Atlantic (Labracherie 1978, 1980a, b), the Gulf of Mexico (Casey *et al.* 1979a, b, c), the North Atlantic (Petrushevskaya 1969), and the Norwegian-Greenland Sea (Bjørklund 1973; Petrushevskaya & Bjørklund 1974). Stratigraphies based on selected taxa have been published for the Miocene-Pliocene of the Norwegian-Greenland Sea by Goll & Bjørklund (1980), and for the Quaternary of the central North Atlantic by Morley & Hays (1979b). Radiolarians from Recent sediments in the western Mediterranean are described by Caulet (1974).

Oligocene - Middle Miocene

Deep Sea Drilling Project cores show that the Middle Tertiary distribution of radiolarian sediments is similar to that of the Late Tertiary, except that fewer of these older sequences in the Indian Ocean contain siliceous microfossils, and their distribution in the eastern Pacific is limited as a result of sea-floor spreading. In the Caribbean region, middle Tertiary sediments frequently contain radiolarians, but they are not present in younger sediments. On the other hand, in the northern Pacific, siliceous microfossils are more prevalent in late than in middle Tertiary sediments. Theyer & Hammond (1974a, b) correlate radiolarian biostratigraphy with magnetic stratigraphy in tropical Pacific cores, and Johnson & Parker (1972) correlate radiolarian and foraminiferal stratigraphies while Sanfilippo & Nigrini (1995) correlate radiolarians, nannofossils and foraminifers in the Pacific, Atlantic and Indian Oceans for the Oligocene-Miocene transition.

Eocene

In deep-sea sequences, Eocene radiolarians occur in the central and western tropical Pacific, the Tasman Sea, scattered patches in the low and middle latitudes of the Indian Ocean, the western Atlantic from the vicinity of the Rio Grande Rise through the Caribbean to Nova Scotia, and in the eastern Atlantic from north-west Africa to the Norwegian-Greenland Sea (Bjørklund & Kellog 1972; Bjørklund 1976a, b; Bjørklund & Goll 1986; Lancelot, Seibold *et al.* (1978); Montadert, Roberts *et al.* 1979; Sanfilippo & Riedel 1979; Tucholke, Vogt *et al.* 1979; von Rad, Ryan *et al.* 1979; Weaver 1976). Sancetta (1979) has described the biogeography of assemblages in the Pacific and Indian Oceans from Eocene to Miocene and Abelmann (1990) those for the Antarctic.

Palaeocene

Radiolarian occurrences of this age are very few. They were encountered by the Deep Sea Drilling Project at isolated sites off eastern America, off Spain and North Africa, in the Tasman Sea, and scattered through the Indian Ocean. In north-west Atlantic Palaeocene occurrences are recorded by several Deep Sea Drilling Project Legs.

ACQUISITIONS FROM LAND

Late Miocene - Recent

Ehrenberg published (1854, 1873, 1875) the results of his radiolarian investigations carried out on Barbados.

In western America, early reports of land-based occurrences of Miocene radiolarians include Campbell & Clark (1944) in California, Mertz (1966) in Peru, and Frenguelli (1941) in Chile. In Japan, one may note works published by Nakaseko (1960, 1963); and in the eastern part of the former USSR those by Kozlova (1960) from Sakhalin, and Runeva (1975) from Kamchatka. A land-based occurrence of Pliocene radiolarians is known from Rotti (Riedel 1953).

SCALE			NORTH EURASIA			OCEAN TROUGHS		
SERIES	SUBSERIES	Stage	FORAMINEFRAL ZONES (MSK 1981, Paleogene commission)	RADIOLARIAN ZONES AND LAYERS (R. Kh. Lipman)	NANNOPLANKTON ZONES (MSK 1981, Paleogene commission)	NP	CP	NANNOPLANKTON AND RADIOLARIAN ZONES (A. Sanfilippo, M.J. Westberg & W.R. Riedel 1981)
OLIGOCENE	UPPER	Chattian	*Speeroldia variabilis*	layers with Cenodiscidae		25 24	19	*Dorcadospyris ateuchus*
OLIGOCENE	MIDDLE	Rupelian	*Spiroplectammina carinata oligocenica*	unknown		23	18 17	*Theocyrtis tuberosa*
OLIGOCENE	LOWER	?	*Globigerina officinalis* (*Lenticulina herrmanni*)	*Cenosphaera almaensis* layers / zone *Phacodiscus licharevi*	*Heliocoponthosphaera reticulata*	22	16	*Theocyrtis tuberosa*
					Coccolithus subdistichus	21	16	
EOCENE	UPPER	Priabonian	*Bolivina anteregressa*	layers with Biosphaeridae	*Discoaster barbadensis*: *Istmolithus recurvus*; layers with *Sphenolithus pseudoradians*	19/20	15	*Thyrsocyrtis bromia*
			Globigerina tropicalis *Globigerina turcmenica*	*H. lentis, T. splendicus, S.tschujenkol* zone *Ellipsoxiphus chabakovi*	*Chiamolithus osmaruensis*	18		
		?	*Hentkenina alabamensis* *Acarinina rotundimarginata*	zone *Conocaryomma aralensis*	*Reticulofenestra umbilica*	17	14	*Podocyrtis goetheana*
	MIDDLE	Lutetian	*Acarinina bulbrooki*	zone *Spongurus biconstricus*	*Nannotetrina fulgens*	16 15		*Podocyrtis chalara* *Podocyrtis mitra*
					Discoaster subblodoensis: *Rhobdasphaera inflata*		13	*Podocyrtis ampla, Thyrsocyrtis triacantha*
				Amphycaridiscus fusoides - *Amphybrachium gracilis* zone	*Discoaster subblodoensis*: Lower subzone	14	12	*Theocampe mongolfieri* *Theocotyle cripthocepia* *Phormocystis striata*
	LOWER	Yprian	*Globorotalia aragonensis*	*Amphycaridiscus fusoides* - *Amphybrachium gracilis* zone	*Discoaster lodoensis*	13/12	11	*Phormocystis striata*
					Marthosterites tribrachiatus		10	*Buryella clinata*
			Globorotalia subbotinae	layers with Spongodiscidae zone *Sethodiscus vialovi* *Ellipsostylus inclarus*	*Discoaster diastypus* *Discoaster binodosus* *Marthosterites contortus*	11	9	*Becoma bidartensis*
PALEOCENE	UPPER	Thanetian	*Acarinina susphaerica*	zone *Cromyodruppa regularia* *Porodiscus ornatus*	*Discoaster multiradiatus*	10		
					Hololithius: *Heliolithus riedeli* *Discoaster gemmeus*	9		*Heliolithus riedeli*
				zone *Cenosphaera caucasica*	*Discoaster kleinpelli*			
	LOWER	Montian	*Globorotalia conicontruncata* *Globorotalia angulata*	zone *Cenodiscus magnus, C. longus*	*Fasciculites tympaniformis*			
				zone *Cenosphaera irregularis* *Canellipsis variabilis*; layers with Prunoidea	*Criciplacolithus tennuis* s.l. *Ellipsolithus macellus*			
		Danian	*Acarinina inconstans* *Globoconusa daubjergensis*	no zone no zone				
			Globigerina taurica					

FIG. 2. — A correlation scheme of zonal division of Paleogene of northern Eurasia and oceanic troughs based on radiolarians, foraminifers and nannoplankton (Lipman 1993).

In Europe, Italian localities provide the majority of our information on Neogene assemblages of the Mediterranean region; summaries by Sanfilippo (1971) and Sanfilippo *et al.* (1973, 1985a) cover many of the mainland localities described by early Italian authors (Vinassa de Regni 1900; Carnevale 1908; Principi 1909; Anelli 1913; Lucchese 1927). In addition Sicilian Late Miocene and Pliocene occurrences have also been described since 1880 by Stöhr and since 1890 by Dreyer (see also Table 1). Calabrian occurrences of Pliocene and Quaternary assemblages are also reported by Seguenza (1880), Guerrera (1881), Pantanelli (1882). Paratethyan Miocene assemblages are described from Central Europe: Romania by Dumitrica (1968), the pre-Carpathians by Runeva (1969) and Austria by Bachmann, Papp & Stradner (1963).

Oligocene - Middle Miocene

Miocene radiolarians are known from Maryland in the eastern North America (Martin 1904). A summary of Caribbean occurrences has been compiled by Sanfilippo & Riedel (1976); particularly significant are the Middle Miocene of Trinidad, Jamaica and Barbados and the Oligocene of the Oceanic Formation on Barbados. Land-based middle Tertiary radiolarian occurrences are described by Takayanagi *et al.* (1976) in the Miocene of Japan, and Runeva (1975) in the Oligocene and Miocene of Kamchatka. An Early Miocene assemblage is recorded from the Andaman Islands (Indian Ocean) by Jacob & Shrivastava (1952).

In Europe, an early Oligocene locality is known in East Prussia (Eisenack 1954). Early Miocene sequences are known from southern Spain (Berggren *et al.* 1976) and northern Italy (Westberg, Sanfilippo & Riedel 1981). Paratethyan occurrences of Early Miocene are described by Barwicz-Piskorz (1978) and Dumitrica (1978).

Lipman (1972) and Kestner (1973a,b) describe Oligocene assemblages from the USSR.

Eocene

Land-based Eocene occurrences in America are recorded by Clark & Campbell (1942, 1945) from California, and by Cunningham (1895), for an occurrence in Mississippi. In the Caribbean region the classic occurrence of Barbados was described by Ehrenberg (1854, 1873, 1875) and Bütschli (1882a, b). An occurrence on Cuba was reported by Palmer (1934) and other localities on Barbados, Trinidad, Cuba, Grenada and Panama are summarized by Sanfilippo & Riedel (1976).

In New Guinea some records are cited by Crespin (1958), in Saipan by Riedel (1957b), and in Kamchatka by Runeva (1975).

In Europe an occurrence is reported in northern Germany by Brandt (1935) and in Israel by Reiss (1952).

In the former USSR, Eocene radiolarians have been recorded in numerous papers (see Table 1).

Palaeocene

In North America, a Palaeocene radiolarian occurrence is recorded in Missouri (Frizzell & Middour 1951), and one in California (Foreman 1968). Sanfilippo & Riedel (1976) recorded an occurrence in Cuba.

In the former USSR, Palaeocene radiolarians are reported by several authors (Table 2).

STUDIES ON RUSSIAN PLATFORM

In analyzing Russian literature we discovered many geographical terms like: *Pre-Caucasus, ZaUralie, Povolshe* and so on, which are unfamiliar to the western reader. Similarly in geological descriptions there are such terms as "*sloi*", "*svita*", "*horizon*" and so on. Here we give an explanation of terms which are currently in use in Russia. For clarity we preserved the original names of the subdivisions (in brackets in the text).

Geographical terminology

– *Chukotka* = Tchouktches = Chukchi.

– *Crimsky*: Crimea.

– *Pre Black Sea* region: territory 400-600 km to the north of the Black Sea, southern Ukraine.

– *Pre Carpathians*: Carpathian folded area and the territory 200-300 km to the east of the Carpathian mountains.

– *Pre-Caspian* (or *Pre-Aral*): the territory to the

north of the Caspian (or Aral) Sea, but in some publications it can be the territory to the east and to the west of Caspian (or Aral) Sea.
– *Pre-Caucasus*: the territory 100 km to the north of the Caucasus.
– *Povolshe* (= *Povolshie*): territory along the right and left banks of Volga river.
– *Predmugodzharie*: Cis-Moudjari.
– *Preduralie* = Pre-Ural = Cis-Ural = West Ural.
– *Priaralie*: western Aral Lake region.
– *Stepnoi Crimea*: middle part of Crimea peninsula, territory near Simferopol.
– *Zauralie* = ZaUralie: territory to the east of Ural mountains (= Trans-Ural).

GEOLOGICAL TERMINOLOGY
Lithology
– *Aleurolites* (or *alevrolite*): sedimentary silty-clay rocks, which contains about 45% very fine grains of sand and more than 55% clay.
– *Argillite*: metamorphosed (low degree) aleurolites.
– *Opoka*: Russian analog of cherts (diatomite, radiolarite type) with a high percentage (more than 70%) of organic silica.

Stratigraphy
(according to A. Zhamoida et al. 1970)
– *Otdel*: a unit of a common ("chronostratigraphic") scale, translated by the term Series (English).
– *Svita*: always translated by the term formation, although in a strict sense this term "formation" does not exactly coincide with its interpretation by many Russian authors, as formation means the basic subdivision of the category of lithostratigraphic units.
– *Horizon*: layer.
– *Pachka*: we translated it as a member and it means literally a member of some larger subdivision (formation).
– *Sloi* and *plast*: there is no clear distinction between the English terms bed and stratum, which incidentally is also the case with the Russian terms *sloi* and *plast*.

In the following part the text is arranged in (1) geographical order (from the West to the East) and (2) by the year of publication. The numbers in square brackets which follows a reference correspond to the numbers used on table 2 and on corresponding location maps.

PRE-BLACK SEA REGION
Pre-Carpathians
Information about Oligocene and Lower Miocene Radiolaria of the Pre-Carpathian area (Vorotyshche, Slonitsa and Tysmenitsa Rivers sections) can be found in papers written by Subbotina (1960, [40]) and Runeva (1969, [39]). In our opinion the assemblage described by Subbotina seems to be redeposited because the taxonomic composition of the radiolarian association discovered in Oligocene-Lower Miocene deposits of the Zagorsky series is unusual. The radiolarian association was found in exotic pieces of breccia. All illustrated specimens are very poorly preserved and the association contains some species of *Dictyomitra*. There is a note in the paper about redeposition of foraminifers especially in sandy strata. Runeva (1969, [39]) discusses this problem in her paper where she introduced the generic composition (only) of Lower Miocene radiolarian associations from the Vorotyshchensky series of the Pre-Carpathian area. The conclusion of the author concerning the Oligocene and Lower Miocene age of Radiolaria bearing deposits from the Vorotyshche, Slonitsa and Tysmenitsa Rivers is that the radiolarian complex is a result of erosion of Cretaceous and Eocene radiolarian bearing deposits and was transported with the transgression of these sediments from the east or south-east.
Lozynyak (1969, 1985, [26]) described Eocene and Oligocene radiolarian assemblages from the Maniavskaya series (Lower Eocene), Bachinskaya bed (Middle, Upper Eocene) and Menilitovaya series (Oligocene) of the Carpathian folded area.

South-western Ukraine
The history of Palaeogene radiolarian studies in the Ukraine begins with Gurov's publication in 1893 (Gorbunov 1971, [9]) where he mentioned the presence of *Haliomma* sp. in Kharkov rocks from the southern areas of Kharkov Province. Information about the existence of Palaeogene radiolarian associations in deposits from Kiev, Chernigov and Poltava Provinces (Koryokovka,

Kholm villages, Volynsk), the Odessa area, the Pre-Black Sea troughs, the Verino pole, and along the Lopanj, Uda, Severskii, Donets and Melovaya Rivers comes from the publications of Titkovsky (1901a), Uspenskaya (1930, 1950a), Kaptarenko-Chernousova (1936, 1948), Pechenkina (1964) (all references from Gorbunov 1971). The most complete data about Paleogene radiolarians of this region can be found in the Gorbunov's monography (1979).

Borisenko (1958, [2]), working in the Krasnodarsky region and Seversky, Abinsky and Psobaisky Districts, has described forty new taxa from a shallow water radiolarian assemblage of Palaeogene deposits of the Psecupskaya Formation (svita). Ten new taxa were described by her (Borisenko 1960b, [3]) from the Upper Palaeocene rocks of the Abasinskaya Formation (svita) of eastern Kuban. The Lower-Middle Eocene deposits of western Kuban (Psecups River, interflow of the Shebsha and Shibica Rivers) contain a shallow water radiolarian association discovered in the Zybzinskaya, Kutaisskaya and Kaluga Formations (svita) (Borisenko 1960a, [4]). The same territory has been studied by Krasheninnikov (1960, [15]) and he presented the description of forty-two new radiolarian taxa (two genera and forty-two species) from Lower, Middle and Upper Eocene deposits from the western Pre-Caucasus (Moldavano-Psifsk and Zybzinsk area). The associations of radiolarians were found together with foraminifers belonging to the *Globorotalia subbotinae* and *Globorotalia aragonensis* Zones. The first radiolarian assemblage from the Zybsinsk series indicates shallow water conditions and the second one, from the Kutaissk series, deep water conditions.

Crimea Peninsula

A Late Palaeocene radiolarian association from the Kachinskaya layer (horizon), an Early Eocene association from Simferopolsky and a Late Eocene association from Bodraksky layer (horizon) of Crimea have been studied by Chedyia (1973 [6], 1981 [8]). The investigator concluded that: (1) there is no correlation between the radiolarian association from Stepnoi and southern Crimea; (2) the Palaeogene assemblages of Radiolaria from Crimea can not be correlated with the same from Middle Asia using normal correlation techniques based on the taxonomic composition of assemblages; (3) the assemblage can be correlated only by cycles of sedimentation. Correlation with Foraminifers showed that the radiolarian association from the Kachinsky horizon occurs with the *Acarinia acarinata* assemblage, the association from Bakhchisaraisky layer (horizon) occurs with the *Operculina semiurvoluta* assemblage, and the association from the Alminsky layer (horizon) with the *Globigerapsis index* assemblage.

Lipman (1982, [22]), working with the deposits of the Rubanovskaya formation in the Lower Serogorsky region of the Khersonsky district, has investigated Oligocene Radiolaria from the northern Pre-Black Sea area and Crimea. She introduced two new radiolarian taxa. The age of the shallow water radiolarian association was confirmed, using foraminifers and molluscs. The results of an investigation carried out by Lipman on Radiolaria from eight sections of Palaeogene deposits in the Bakhcnisaraisky district were published in 1984a [23]. She discovered associations of Radiolaria in outcrops of Upper Palaeocene to Lower Oligocene deposits from the Kasha River and Suvly-Kaya Mountain (Upper Palaeocene), the Belbek River (Lower Eocene), the Alma River (Middle-Upper Eocene) and Kizil-Djar Mountain (Upper Eocene-Lower Oligocene). All assemblages of Radiolaria occur together with foraminiferal zonal associations: *Acarinina subsphaerica*, *Globorotalia subbotinae*, *Hantkenina alabamensis*, *Globigerapsis tropicalis*, *Bolivina antegressa* and *Lenticulina hermanni*. In a second paper published by Lipman (1984b, [24]) correlation of zonal stratigraphical schemes, based on radiolarian and foraminifers, from the Palaeocene and Eocene deposits of the Pre-Caucasian and Apsheron peninsulae was introduced. The investigator applied her own zonal subdivision, based on radiolarian data for the Cherkessky key-section of the Pre-Caucasus and made a correlation between zonal radiolarian associations and assemblages described by Borisenko (1960a, [4]) and Krasheninnikov (1960, [15]) for western Kuban and by Mamedov (1970, [30]; 1973b, [32]) for the Apsheronian peninsula.

		North- Caspian Area	Don River	Middle Volga Area	East Ural Slope	West Siberian
EOCENE	UPPER	T. andriashevi	T. andriashevi			
	MIDDLE	E. polysiphonia	E. polysiphonia			
		C. alta	C. alta			
		H. quadratus	H. quadratus			
		L. separatum	L. separatum	L. separatum ?		
		H. hexasteriscus	H. hexasteriscus	H. hexasteriscus	H. hexasteriscus	
	LOWER	H. lentis	H. lentis	H. lentis	H. lentis	H. lentis
		S. paciferus			S. paciferus	
		P. fiscella		P. fiscella	P. fiscella	P. fiscella
PALEOCENE	UPPER	Ph. cubensis	P. foveolata	P. foveolata	P. foveolata	P. foveolata
			T. sengilensis	T. sengilensis	T. sengilensis	
		B. tetradica		B. tetradica		
		T. larnacium				
	LOWER			B. alifera	B. alifera	B. alifera

FIG. 3. — Correlation of radiolarian zones among North Caspian, Don River, Middle Volga, East Ural and West Siberian areas (from Kozlava 1993).

RUSSIAN PLATFORM

Upper Palaeocene and Lower to Upper Eocene radiolarian bearing deposits from the Voronesh anticline have been studied by Tochilina (1969, [41]; 1975). Radiolaria were not found in Oligocene deposits from that region. The shallow water radiolarian associations occur together with foraminifers and molluscs. Three faunal periods closely connected with transgressions and regressions are established in this paper:

1. Late Palaeocene (Veshenskaya formation [*svita*]) - Early Eocene (Sheptukhovskaya formation [svita]);

2. Late Eocene (Tishkinskaya formation [*svita*]);

3. Late Eocene (Kasianovskaya formation [*svita*]).

The author compared faunal associations in deposits of the Voronesh anticline (Russian Platform) with that of the Pre-Caucasian and eastern slope of the Ural mountains and found many common species.

The southern part of Russian Platform has been studied by Zagorodnyuk (1969, [43]; 1975, [44]; 1981, [45]). She also investigated Radiolaria from the Asovo-Kubansk trough, Salo-Manyhsk interflow and the basin of the northern Emba (Pre-Caspian lowland). She recognized three different radiolarian associations for the Lower flow of the Don River and four assemblages in the Pre-Caspian lowland. Investigating the transition between some representatives of

Amphibrachium and *Histiastrum* she found out that: (1) apparently they have a common ancestor; and (2) preservation of the shells improves to the north.

The Lower Don basin and northern Pre-Caspian Eocene deposits served as a basis for Nikitina and Zagorodnyuk's (1981, [37]) study in which they carried out a correlative analysis of foraminiferal and radiolarian distribution within these rocks. The authors give a correlation between regional zones based on planktonic foraminifers and radiolarian zones, proposed by Zagorodnyuk (1967) for shallow water associations.

The scheme proposed in this paper does not correlate with the zonal subdivision based on Radiolaria data established by Lipman (1972, [20]; 1993, [25]) for Palaeogene deposits of the former USSR.

Palaeogene deposits of the same territories have been studied by Kozlova (1990, [13]; 1993, [14]); she established nine zonal subdivisions which correlated with radiolarian zones proposed by her for the Middle Volga, East Ural slope and West Siberia.

The existence of three zonal schemes for the same region reflects the difference in approach to the establishment of radiolarian biostratigraphical zonal subdivisions. First there is a problem because of the large number of hiatuses in the studied sections. Second there is a problem in deciding which species to use as a basis for a zonal scheme. This question was not clearly discussed by Nikitina & Zagorodnyuk (1981, [37]) or Zagorodnyuk (1981, [45]).

Lipman (1993, [25]) and Kozlova (1990, [13]; 1993, [14]) suggested that the number of events in the association of Radiolaria should be the main characteristic for the zonal boundary. However, Lipman tried to apply to the ga-Don Basin the scale she established for the western Siberia lowland and then tried to trace it to many regions of the country; whereas Kozlova attempted to apply (partially) the scale proposed by Foreman (1973) for the Gulf of Mexico. It is difficult to say now which attempt is the best and will be the most fruitful. In our opinion it is an important problem to be studied within the Peri-Tethys programme.

MIDDLE PART OF VOLGA RIVER FLOW (MIDDLE POVOLSH'E)

Radiolaria from this region have been studied by Lipman (1969, [19]) and Kozlova (1984a, b, [12]; 1990, [13]; 1993, [14]). For the Upper Palaeocene-Middle Eocene three versions of a zonal subdivision have been suggested. First, Kozlova (1984b, [12]) attempted to apply some biostratigraphical subdivisions suggested by Foreman (1973) for the Gulf of Mexico. Second, Kozlova (1990, [13]) proposed a zonal scheme based on morphotypic lineages of the genera *Axoprunum, Heliodiscus, Tripodiscinus, Clathrocyclas, Lychnocanium* and *Phormocyrtis*. This investigation showed the impossibility of using *Buryella clinata* and *Spongotrochus paciferus* as index-species for this region. Instead Kozlova suggested *Phormocyrtis striata* and *Heliodiscus lentis* zonal subdivisions for the Lower Eocene time interval. The first one (*P. striata*) of the index species is absent in a third version biostratigraphical scheme (Kozlova 1993, [14]). A new zone, *Heliodiscus hexasteriscus*, was suggested for the upper Lower Eocene and lower Middle Eocene deposits and the author puts a question mark for the Middle Eocene *L. separatum* Zone in the middle Volga area indicating that the establishment of this zonal subdivision is still under discussion.

TOURGAISK TROUGH AND NORTHERN PRE-ARAL

The Oligocene radiolarian association was discovered by Kestner (1973).

Investigations of Eocene Radiolaria in this area were carried out by Lipman (1965a, b, [17, 18]; 1969, [19]; 1972, [20]; 1975a, b, [21]) and Kozlova (1990, 1993). The most complete information about Palaeogene Radiolaria from the Tourgaisk Trough and northern Pre-Aral region is given in papers written by Lipman (1965, 1969, 1972, 1975a):

1. The distribution of ninety-eight radiolarian species in the Tourgaisk's Trough and northern Pre-Aral Eocene deposits is shown in the first paper (Lipman 1965a) of this series.

2. Two zonal subdivisions based on radiolarian data are established: *Spongurus biconstrictus* - Middle Eocene (lower part of Tasaransk series) and *Ellipsoxiphus chabakovi* - Upper Eocene

	FORAMINIFERAL ZONES OF THE SOUTHERN USSR (Krasheninnikov 1971; MSK USSR 1981, 1985)		RADIOLARIAN ZONES		
LATE EOCENE	*Globigeraspis tropicalis*	●	*Theocyrtis andriashevi*		
MIDDLE EOCENE	*Globigerina turcmenica*	●	*Ethmosphaera polysiphonia*		◆
		●	*Cyrtophormis (?) alta*		◆
	Hantkenina alabamensis	●	*Heliodiscus quadratus*		
	Acarinina rotundimarginata	●	*Lychnocanium separatum*		
	Acarinina bulbrooki	●	*Heliodiscus hexastericus*		
EARLY EOCENE	*Globorotalia aragonensis* s.l.				
	Globorotalia subbotinae s.l.	●	*Heliodiscus lentis*		◆
		●	*Petalospyris fiscella*		⬟
LATE PALEOCENE	*Acarina acarinata*		● *Phormocyrtis cubensis*	*P. foveolata*	
				T. sengilensis	
	Acarinina subspherica	●	*Buryella tetradica*		
	Globorotalia angulata s.l.	●	*Thecosphaera larnacium*		
EARLY PALEOCENE			*Buryella (?) alifera*	*Cromyocarpus (?) ovatus*	

● Planktonic foraminifers ◆ Nannoplankton ⬟ Dinoflagellates

FIG. 4. — Foraminiferal zones of South Eurasia compared to radiolarians zones (from Kozlova 1993).

(upper part of Tasaransk series).

3. *Spongurus biconstrictus* association of Radiolaria occurs together with foraminifers *Nummulites distans, N. murchissoni, Cibicides eocaenus, Bulimina mitgarsinae.* She believed these sediments to be analogous to the Alaisk stage of Central Asia, and to the Buchagsk series of the Russian platform.

4. *Ellipsoxiphus chabakovi* occurs together with the foraminifer *Spiroplectammina spectabilis.* The radiolarian association can be correlated with Upper Eocene deposits from the Turkestan Stage of Turkmenia, Kyzyl-Kum, and from the Ljulinvorsk Series of the western Siberian lowland.

5. In the deposits from the Saksaul Series one can see a third association of Upper Eocene (shallow water association) Radiolaria. The Upper Eocene age of the stratum is confirmed by molluscs (*Pectunculus aralensis)*, and by foraminifers (*Bolivinopsis carinatiformis* etc).

6. The first assemblage of radiolarians was discovered in the deposits of the northern Aral Sea coast sections and on Cape Isendy-Aral in thin layered dark, greyish-grey clays, which were deposited above the nummulitic limestones, and also in marly clays and in the marls from wells of the Chagraisk plateau, in the Tumaly-Kolj village at Lake Tebez, in Chelkar, on Mount Tas-Aran,

AGE		FORMATION	Paleontological characteristics of zone	
			Foraminiferal zone	Radiolarian zone
PALEOGENE	UPPER EOCENE	Upper Coun	*Bolivina - Nonion curviseptum*	
			Globigerinoita index	*Cromyocarpius echinatus*
		Middle Coun	*Globigerina turcmenica*	*Sethopyramis victori* *Stylatractus pictus*
	MIDDLE EOCENE	Lower Coun	*Globigerinoides subconglobatus*	*Azerbaidjaniyus compositus* : *Stylotrochus schweeri*
			Globorotalia crassaformis	
			Globorotalia aragonensis - caucasica	*Anthocyrtidium apsheronense* *Cornutella fimbriata*
	LOWER EOCENE		*Globorotalia subbotinae*	*Astrosestrum dialiensis* *Ellipsostylus ancorarius*
	UPPER PALEOCENE	*Sumgaitskaya*	*Globigerina velascoensis* and aglutinised foraminifera	

FIG. 5. — Scheme of Radiolaria and Foraminifera's zonal correlation in Shemakhino-Kobistanskaya and Apheronian peninsule areas of Azerbaidzan (Mamedov 1973b).

in the Turgay and in several wells along the River Ashchis and in the Irgis area. This complex is also traced in the Buchagsk Series in the southern part of the Russian Platform.

7. The second assemblage of radiolarians was encountered in sections of Mount Tas-Aran, on the northern coast of Tsche-Bas Bay, the Aral Sea and in several wells located on the Chagraisk Plateau in the Tumaly-Kolj village at Lake Tebez, in Chel-kar and in Turgay.

8. According to Lipman, the majority of radiolarian assemblages she investigated are characteristic of a shallow water basin. In addition to this general conclusion we should say, that in Middle Eocene radiolarian assemblages studied one can see many representatives of Nassellaria, which are not present in Late Eocene associations and this might indicate a difference in water depth.

The investigation carried out by Lipman on the Palaeogene biostratigraphy of this region was taken into account by Kozlova (1984, [12]). In her study of Palaeogene Radiolaria from the East Ural slope she incorporated in her new zonal scheme some zonal subdivisions proposed by Lipman. However, she referred her Upper Eocene *Heliodiscus lentis* Zone to the Lower Eocene and subdivided the *Ellipsoxiphus chabakovi* Zone into two new zones, the *Petalospyris fiscella* Zone and *Spongotrochus paciferus* Zone. She also introduced four new radiolarian species.

PRE-CASPIAN REGION

The Pre-Caspian territory is very large with its eastern part belonging to Turkestan, its western part to Azerbaidzan, and the northern part to Russia. We start our description with the western part.

The western part of Pre-Caspian region (Azerbaidzan)

Shemakhino-Kobistanskaya and Apsheronian peninsula areas served as a basis for Mamedov's (1969a, b, c, [27-29]; 1970, [30]; 1973a, b, [31, 32]; 1975, [33]) investigations of Palaeocene-Eocene Radiolaria discovered in the Lower-Upper Coun Formation. Twenty-nine new taxa were described in his papers, and the first division of Eocene deposits according to radiolarians was established (Mamedov 1973a, [31]).

Species mentioned by Mamedov as characteristic of the western Pre-Caspian region are not found in the zonal scheme established by Lipman for the Apsheron Peninsula and Pre-Caucasus, despite the fact that both biostratigraphical subdivisions are based on radiolarian data and were correlated with the same foraminiferal zones. However, it is possible to carry an indirect, but not pure graphical, correlation between these two zonations for Lower-Upper Eocene deposits. Unfortunately, we can not say the same about the biostratigraphical scheme established for the northern Pre-Caspian region by Kozlova (1993, [14]).

In this case it is possible to use graphical correlation methods only since the author gave a comparison between her radiolarian biostratigraphical zonation with that based on foraminifers, which had been suggested by Krasheninnikov (1971) and approved by MSK USSR (1981, 1985) for the southern part of former USSR territory (this scheme is different to the one given in Mamedov's paper).

In a previous article Kozlova (1984a), using the same scale, correlated some, but not all, radiolarian zones with some diatom zones. Thus, *Buruella tetradica* zone (Foreman 1973) has been correlated with lower part of the *Trinacria ventriculosa* diatom zone (Gleser 1979), *Petalospyris fiscella* (Kozlova 1984a) with *Coscinodiscus payeri* (Gleser 1979), *Spongotrochus paciferus* (Kozlova 1984a) with the lower part of *Pyxilla gracilis* (?), and *Heliodiscus lentis* with the upper part of *Pyxilla gracilis* (?).

The eastern part of the Pre-Caspian region, Middle Asia

Radiolaria were found and studied in the Palaeogene deposits of Middle Asia (Lipman 1950, [16]; 1953; Chediya 1957, 1981; Moksyakova 1961, [35]; 1965, [36]; Kreidenkov & Chediya 1971; Kestner 1971, [10]) in exposures and wells of eastern Turkmenia, Bukharo-Khivinsk depression and south-western spurs of the Gissarsk mountain range, Tadzhiksk depression and Fergana. Eocene Radiolaria from the Turkestanian Stage have been studied by Lipman (1950, [16]). She described eighteen new species found in outcrops in Kyzyl-Kum, Tamdy, Shchulj trough, western slope of Tamdinsk stage, Ak-Oi, and in the wells near Dzhanhoi, Usun-Kuduk and Chetyr [16]. The next investigation of Upper Eocene radiolarians from Kumsky horizon of Western Turkmenia was carried out by Moksyakova (1961, [35]). The investigator described eighteen new taxa. Nevertheless the radiolarians association cannot be referred to a typical shallow water assemblage, because of the eight species of *Nassellaria* present. The next paper of Moksyakova (1965, [36]) was devoted to Upper Eocene Radiolaria from the Kuberlinsk and Kerestinsk horizons of south-eastern Turkmenia, Kyzyl-Kum and western Turkmenia (Ustyurt and Krasnovodsk plateau). The descriptions of ten new radiolarian taxa are given in this paper. The author presents a correlation (on the contrary to Chediya (1981) between the Bodraksky Stage of Crimea stratotype section and Kyberlinsky, Kerestinsky and Kymsky horizons of Turkmenia. She referred the Beloglinsky horizon of Turkmenia to Alminsky in Crimea. Kestner (1971, [10]) discovered twelve genera of *Nassellaria* (*Tripospyris*, *Lychnocanium*, *Sethopyramis*, *Sethocyrtis*, *Lophophaena*, *Podocyrtis*, *Theocorys*, *Theocyrtis*, *Tricolocampe*, *Theocampe*, *Lithostrobus*, *Eucyrtidium*) in Lower-Upper Eocene deposits of Beloglinsk, Kuberlinsk-Kerestinsk and Kumsk horizons. He referred Lower Eocene deposits to Bakhchisaraisky, Middle Eocene to Simferopolsky and Late Eocene to Bodraksky stages of the Black Sea stratotype section. The majority of these genera (eleven) were found in Upper Eocene deposits together with the following foraminifers:

Acarinina rotundimarginata, *Hantkenina alabamensis* and *Globigerinoides subconglobatus*. One genus was found in Early Eocene deposits together with *Globorotalia acqua* and *G. subbotinae*. The Middle Eocene radiolarian association occurs together with *Globorotalia aragonensis* and *Acarinina crassaformis*. In the paper written by Averburg & Kestner (1973) one can find the correlation made between radiolarian and foraminifer zones of this region.

Chediya (1973, [6]) investigated an Early Eocene association of Radiolaria in the Suzaksk area, a Middle Eocene association in the Alaisk area, and a Late Eocene association in deposits of the Bukharo-Khivinsk depression. Judging from lithologic composition of the rocks and fauna described in this publications, the sea in this area was during the Early Eocene a shallow water basin, which became deeper in the Middle Eocene and reached its maximum depth in the Late Eocene.

Unfortunately, information about Palaeocene radiolarian associations discovered in this area is incomplete. We found only one paper (Chediya *et al.* 1971, [5]) dealing with micro- and macrofaunal studies from the Bukharsk layers exposed in the mountain ranges of Peter-the-First, Khodzha-Kasian, Aryk-Tan, Istum-Tay and in the area Kichik-donguz elevation. Three new radiolarian taxa have been described in it. The association of Radiolaria occurs together with foraminifers. Underlying and overlapping layers contain coral, pelecypods, gastropods, brachiopods, ostracods, other macrofauna and small and large foraminifers.

CONCLUSION

As mentioned previously by Sanfilippo *et al.* (1985), in comparison with the amount of evidence available for calcareous microfossil groups, there are few localities for which the change from the Mesozoic to the Cenozoic radiolarian fauna can be traced. The available evidence indicates a profound decline in radiolarian diversity at the Cretaceous-Tertiary boundary. A high proportion of Mesozoic genera and families became extinct with only a few surviving into the Early Palaeocene. By early Eocene time, however, radiolarian genera and species had attained the diversity that they exhibited during the Cretaceous and throughout the later Cenozoic (Riedel & Sanfilippo 1981). Thus the radiolarians clearly fulfil one of the requirements for stratigraphic utility, namely taxonomic diversity - but what about their rate of evolutionary change ? Due to the great taxonomic diversity of the Cenozoic radiolarians, it is not wise to expect that all species will be comprehensively known in the near future. Therefore choices will have to be done on which ways the possible research will be conduct for radiolarian knowledge. Taxonomy must reflect phyletic relationships, not geometric ones as in the Haeckelian system. We are approaching this capability in some families but are far from it for most of the spumellarian families. To achieve such goals, it is necessary to record diversity and stratigraphical ranges from countries, which were somehow neglected until now, such as the Russian platform.

Studying the available literature in this field we have been faced with some problems. The majority of them deal with the establishment of a biostratigraphical scheme. Some of the problems have "objective" reasons:

1. The connection between some parts of Peri-Tethys was not constant during Palaeogene.

2. All processes of sedimentation were strongly influenced by transgressions and regressions within the basin; therefore there is very limited number of sections within the former Peri-Tethyan basin in which one does not find numerous hiatuses in radiolarian distribution.

3. Some parts of the Peri-Tethys at that time had long-lived basins with a well developed shallow water radiolarian fauna and this phenomena makes correlations between distant parts more difficult and indirect.

Besides these objective reasons there are some "subjective" reasons:

1. Scientists have been using different bases for the establishment of a biostratigraphic zonation.

2. The age determination of Palaeogene deposits in some regions (for example in Middle Asia) should be redone because the radiolarian assemblage was studied in thin sections only, or because the radiolarian association was described only at the generic level.

3. Long distance correlations requires that the taxonomy of many species be revised, as many identifications were based only on drawing.

Resolution of the difficulties mentioned above may help us to understand the reasons for the existence of two different zonal scales, one proposed by Lipman (1993) and the other by Kozlova (1993).

During the present review it became apparent that:

1. The presence of Oligocene-Lower Miocene radiolarian assemblages in the deposits exposed in Carpathian folded area had not been proven.

2. There was a contradiction between the palaeoenvironmental reconstructions of Lipman (1965) and of Kestner (1971), both of which were based on radiolarian associations from Eocene deposits of the Bukharo (Khivinsk depression and south) western spurs of the Gissarsk mountain range. According to Lipman's data the Upper Eocene radiolarians belong to a shallow water assemblage, but Kestner's data suggest that the Upper Eocene radiolarian association is characteristic of deep water conditions.

Finding the solutions to these two relevant problems would be appropriate and fruitful lines for future research within the Peri-Tethys project.

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TABLE 1. — Publications on Cenozoic radiolarians ordered by geographical regions (except publications dealing with the European part of the former Soviet Union [see Table 2]).

LOCATION	AGE	TOPIC	AUTHOR
	Quater.		Cachon J. *et al.* 1978
	Quater.	Evolut. Cytol. Ultrastruct.	Cachon J. & Cachon M. 1978a
	Quater.	Biol. Cytol. Ultrastruct.	Cachon J. & Cachon M. 1978b
	Quater.	Taxon. Evolut.	Cachon J. *et al.* 1977b
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1977
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1976a
	Czc	Taxon.	Goll R. M. 1972a
	Recent	Biol. Cytol. Physiol.	Cachon J. *et al.* 1977
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1979
	Recent	Biol. Cytol. Physiol.	Cachon J. & Cachon M. 1980
	Czc	Evolut.	Kellogg D. E. 1983
	Czc	Evolut.	Kellogg D. E. 1980
	Quater.	Sedim. Climat. Season. product. Ecol.	Casey R. E. *et al.* 1971
	Czc	Evolut.	Kellogg D. E. & Hays J. D. 1975
	Czc	Taxon. Strat.	Campbell A. S. 1954
	Recent	Biol. Atlas General	Cachon J. & Cachon M. 1982a, b
	Recent	Ultrastruct. Reproduct. Biol. Cytol.	Cachon J. *et al.* 1985
	Czc	Taxon. N.Sp.	Campbell A. S. 1951
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1975
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1974
	Czc Mzc	Biostrat.	Boltovskoy D. 1988
	Recent	Preserv.	King K. 1977
		General Technics Preparation	Boltovskoy D. *et al.* 1983
	Quater.	Current Sedim.	Boltovskoy D. 1988
	Recent	Biol. Physiol. Reproduct.	Kling S. A. 1971a
	Mzc-Czc	General Strat. Evolut.	Kling S. A. 1978
		Preserv. Plankt.	Boltovskoy D. 1981
	Czc Mzc	DSDP6	Kling S. A. 1971b
	Recent	Physiol. Cytol.	King K. 1975
	Recent	Biol. Physiol. Cytol. Diagen.	King K. 1974
	Recent	Biol. Cytol. Skelet.	Cachon J. & Cachon M. 1972a, b, c
	Quater.	Biol. Skelet. Physiol.	Cachon J. & Cachon M. 1971b
	Quater.	Cytol. Biol.	Cachon J. & Cachon M. 1971a
	L.Eoc.	Taxon. N.Sp.	Brandt R. 1935
	Czc	Taxon Evolut.	Kellogg D. E. 1975
	Neogene	Strat. Environ.	Casey R. E. & Reynolds R. A. 1980
		Taxon. Biol. Strat. General	Goll R. M. & Merinfeld E. G. 1979
	Czc	Taxon. N.Sp.	Haeckel E. 1881
	Czc	Taxon. Evolut. Skelet.	Dumitrica P. 1983
	Czc	Taxon. N.Sp.	Haecker V. 1908
	Czc	General Taxon.	Dumitrica P. 1979
	Czc Quater.	Taxon. N.Sp. Oc.	Haeckel E. 1887
	Czc	DSDP1	Ewing M. *et al.* 1969
		Taxon. Strat. General	Funnell B. M. & Riedel W. R. 1971
		Strat. Taxon. DSDP9	Goll R. M. 1972b
	Czc	Taxon. Evolut.	Goll R. M. 1976a
		DSDP38 Taxon.	Goll R. M. 1976b
	Recent Quater.	Plankt. Biol. Physiol.	Febvre J. 1982
	Neog.-Quater.	Evolut. Taxon.	Goll R. M. 1979
		Biol. Ecol.	Harbison G. R. *et al.* 1977

LOCATION	AGE	TOPIC	AUTHOR
	Czc-Quater.	Taxon. N.Sp.	Dreyer F. 1889
	Paleog.	Biozon. Strat.	Cavelier C. & Pomerol C. 1977
	Czc-Quater.	Biol. Evolut. Taxon. Cytol.	Hollande A. & Enjumet M. 1960
	Eoc.		Chediya D. M. 1973
	Czc-Quater.	Biol. Cytol. Physio.	Hollande A. & Hollande E. 1976
	Mzc-czc	General review Sedim.	Hill W. 1912
	Quater.	Biol. Physiol.	Herring P. J. 1979
	Czc	Evolut. Extinct. Quater.	Hays J. D. & Shackleton N. J. 1976
	Mzc-Czc	DSDP16 Strat.	Dinkelman M. G. 1973
	Czc	Taxon.	Deflandre-Rigaud M. 1969
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	Mzc-Czc	Distrib. Sedim. Paleog.	Hein J. R. & Parrish J. T. 1987
	L.Pleist. Quater.	Evolut.	Knoll A. H. & Johnson D. A. 1975
	Quater.	Biol. Cytol.	Cachon J. & Cachon M. 1976b
		Climat. Ecol. Environ.	Kruglikova S. B. 1989
	Czc? Mzc?	Ecol. Oceanol. Biogeog.	Kruglikova S. B. 1984
	Mioc.-Quater.	Strat. DSDP12	Benson R. N. 1972
	Quater.	Biol. Physiol.	Anderson R. O. 1980
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	Quater.	Biol. Cytol.	Anderson R. O. 1976b
	Quater.	Biol. Cytol.	Anderson R. O. 1977a
	Quater.	Biol. Cytol.	Anderson R. O. 1977b
	Quater. Recent	Ecol. Strat.	Kruglikova S. B. 1981
		Skelet. Physiol. Biol.	Anderson R. O. 1986a, b
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	Quater.	Recent Biol.	Anderson R. O. & Rottger R. 1986
	Quater.	Biol. Skelet.	Anderson R. O. *et al.* 1986b
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		Biol. Evolut.	Anderson R. O. 1985a
	Quater.	Biol. Skelet.	Anderson R. O. 1981
	Czc-Quater.	Biol. Physiol.	Lecher F. 1978
		Biol. Cytol.	Anderson R. O. 1976a
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	Czc	DSDP31	Ling H. Y. 1975
	Czc	DSDP40	Pisias N. G. & Moore T.C. Jr 1978
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		Taxon. Strat.	Riedel W. R. & Sanfilippo A. 1977
	Czc	Taxon. Strat. Evolut.	Riedel W. R. & Sanfilippo A. 1978a
	Eoc.-Oligoc.	Geochron.	Riedel W. R. & Sanfilippo A. 1986
	Recent	Phaeodar. Preserv.	Runeva I. P. & Reshetnyak V. V. 1979a, b
		Taxon. Strat. Evolut.	Riedel W. R. & Sanfilippo A. 1982
		Taxon. Strat. Evolut. Skelet.	Riedel W. R. & Sanfilippo A. 1981
	Recent	Plankt. Sedim. Environ.	Riedel W. R. & Saito T. 1979
	Czc	Skelet. Taxon. Ontog. Phylo.	Petrushevskaya M. G. 1987
	Pzc Mzc Czc	Taxon. Skelet.	Petrushevskaya M. G. 1986
	Czc	Strat. DSDP	Olson R. K. & Goll R. M. 1970
	Czc Quater.	Skelet.	Nishimura A. 1982
	Mioc.-Quater.	Bibliog.	Nigrini C. A. & Moore T. C. 1979
	Mioc.	Taxon.	Nakaseko K. *et al.* 1983
		Biol. Taxon. Plankt.	Page F. 1984
		Taxon. Skelet.	Petrushevskaya M. G. 1975b
	Pzc Mzc Czc	Taxon. Evolut. Skelet.	Petrushevskaya M. G. 1981a
		Taxon. Skelet.	Petrushevskaya M. G. 1975a
	Quater.	Taxon. Paleogeog. Plankt.	Petrushevskaya M. G. 1972b
	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1972a
	Recent	Sedim.	Takahashi K. & Ling H. Y. 1984
	Recent	Sedim. Preserv.	Takahashi K. 1984
	Recent	Preserv. Sedim.	Takahashi K. 1983
		Paleog. Geogr.	Worsley T. R. & Jorgens M. L. 1974
	Mzc Czc	Techn.	Yogo S. 1982
	Recent	Biol.	Swanberg N. R. *et al.* 1986a, b, c
	Recent	Biol. Skelet. Taxon. N.Sp.	Swanberg N. R. *et al.* 1985
	Neog.	Taxon. Strat. Zones	Sanfilippo A. *et al.* 1985b
		Taxon. Skelet.	Schaaf A. 1981
	Neog.	Taxon.	Sanfilippo A. & Riedel W. R. 1980
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	Neog.	Taxon. Strat.	Sanfilippo A. 1980
		General	Shrock R. R. & Twenhofel W. H. 1979
	Recent	Biol.	Swanberg N. R. & Anderson R. O. 1985
	Czc Recent	Biol.	Swanberg N. R. 1984
	Czc	Biol. Environ.	Swanberg N. R. 1983
	Mzc Czc	Environ. Ecol. Geogr. Current	Spaw J. M. *et al.* 1979
	Czc	DSDP27	Renz G. W. 1974
	Oligoc.-Mioc.	Evolut.	Moore T. C. 1972
	Czc	Strat. Taxon. DSDP8	Moore T. C. 1971
	Czc Mzc PZ	General	Lipman R. Kh. *et al.* 1979
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	Czc Mzc	Evolut. Taxon.	Lipman R. Kh. 1975c
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	Czc-Quater.	Biogeog. Ecol. Climat.	Morley J. J. 1980
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	Eoc.	Taxon. Strat.	Mato C. Y. & Theyer F. 1980
	Cret.-Czc	Taxon. Strat. DSDP10	Foreman H. P. 1973
	Cret.-Czc	Taxon. Evolut.	Dumitrica P. 1985
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	Czc Mzc?		Levykina I. E. 1984

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	Paleog.-Quater.	Taxon. Strat.	Sanfilippo A. & Riedel W. R. 1982
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	Pzc Mzc Czc	Taxon.	Riedel W. R. 1967b
	Quater.	Skelet. Preserv. Struct	Bjørklund K. R. & Goll R. M. 1985a, b
		Strat. Taxon. DSDP17	Moore T. C. 1973a
Atlant.		Taxon. Strat. DSDP1	Riedel W. R. & Sanfilippo A. 1970
Amer.C. Atlant.W. Carib.		Taxon. Strat. DSDP15	Riedel W. R. & Sanfilippo A. 1973
Amer.C. Barbados Les Antilles	Paleoc.-Mid.Miocene		Biju-Duval B. *et al.* 1985
Amer.C. Carib.	Czc	Taxon.	Riedel W. R. & Hays J. D. 1969
Amer.C. Carib.	Eoc. Oligoc.	Strat. Tektite Extinc.	Maurrasse F. & Glass B. P. 1976
Amer.C. Carib.	Czc	Paleog. Ecol. Climat. Sedim.	Maurrasse F. 1976
Amer.C. Carib. Medit. Pacif.	Paleoc.-Neog.	Taxon. Strat. DSDP10	Sanfilippo A. & Riedel W. R. 1973
Amer.C. Carib. Cuba	Czc		Albin E.-F. 1986
Amer.C. Carib. Cuba La Habana	Paleoc.-Eoc.		Albin E.-F. Fernandez G. 1985
Amer.C. Costa Rica	L.Miocene	DSDP 69	Hein J. R. *et al.* 1983b
Amer.C. W.Costa Rica.	Cret.-Paleog.	Sedim.	Hein J. R.*et al.* 1983a
Amer.C. Barbados	L.Eoc.-E.Olig.	Evolut. DSDP 77B 289	Sanfilippo A. 1988
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Amer.N.	Eoc.-Oligoc.	Extinct. Evolut. Biozon.	Glass B. P. *et al.* 1978
Amer.N.	Eoc.-Oligoc.	Tektite Evolut. Extinct.	Glass B. P. & Crosbie J. R. 1982
Amer.N. Alabama Mississippi	Eoc.	Taxon. Strat.	Cunningham K. M. 1895
Amer.N. Asia Australia Africa	Eoc.	Extinct. Evolut. Tektite	Glass B. P. *et al.* 1979
Amer.N. C.Calif.	Eoc.	Taxon. Strat. Environ.	Blueford J. R. 1988
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Amer.N. Calif.	Recent	Current Climat. Environ.	Boltovskoy D. & Riedel W. R. 1987
Amer.N. Calif.	Czc Mioc.	Strat.	Poore R. Z. *et al.* 1981
Amer.N. Calif.	M.Mioc.	Strat.	Price A. B. 1975
Amer.N. Calif. Antar.C.	Neogene	Strat. Climat. Environ. Ecol.	Casey R. E. 1972
Amer.N. Calif. Barbados	Paleog.		Saunders J. B. *et al.* 1984
Amer.N. Calif. Francisc.	Czc	Taxon.	Riedel W. R. & Schlocker J. 1956
Amer.N. Calif. Pacif.	Quater.	Strat. Taxon.	Benson R. N. 1966
Amer.N. Calif. Monterey	Mioc.	Strat.	Price A. B. 1975
Amer.N. Calif. Monterey Baja	Mioc.-Plioc.	Strat. Environ.	Weaver F. M. *et al.* 1981
Amer.N. Carib. Atlant. Mexico		Extinct Tektite Evolut.	Glass B. P. & Zwart M. J. 1979
Amer.N.	Eoc.-Oligoc.	Evolut. Extinct.	Glass B. P. & Zwart M. J. 1977
Amer.N. Maryl.	Mioc.	Taxon.	Martin G. C. 1904
Amer.N. N.Calif.	Eoc.	Strat.	Blueford J. R. & Brunner Ch. 1984
Amer.N. S.Calif. Pacif.	Neog.	Ecol. Environ.	Casey R. E. *et al.* 1972
Amer.N. SE.Missouri	Paleoc.-Eoc.	Taxon.	Frizzell D. L. & Middour E. S. 1951
Amer.N. USA	Neog.		Palmer A. 1984
Amer.N. W.C.Calif.	Eoc.	Environ. Oceano.	Blueford J. R. & White L. D. 1984
Amer.S. Chile Tripoli		Taxon. N.Sp. Strat.	Frenguelli J. 1941
Amer.S. S.Brasil	Quater.		Kotzian S. C. B. 1984
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Antar.	Czc-Quater.	Climat. Environ. N.Sp.	Hays J. D. 1965

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Antar.	Plioc-Quater.	Climat.	Keany J. & Kennett J. P. 1972
Antar.	Cenozoic	Strat. Biogeog.	Kennett J. P. 1976
Antar.	Quater.	Environ.	Kennett J. P. 1979
Antar.	Plioc.	Taxon. Strat.	Keany J. 1979
Antar.	Neog.	Taxon.	Coco B. C. 1982
Antar.	Mioc.-Quater.	Strat.	Nakaseko K. 1959a
Antar.	Mioc.-Quater.	Strat.	Nakaseko K. & Nishimura A. 1982
Antar.	Czc Quater.	Plankt.	Schroder O. 1906
Antar.	Czc	Taxon. Phaeodar.	Popofsky A. 1908
Antar.	Quater.	Taxon. Climat.	Riedel W. R. 1958
Antar.	Czc-Recent		Popofsky A. 1917
Antar.	Czc-Recent	Ecol.	Popofsky A. 1913
Antar.	Czc-Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1967
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Antar. Arct. Polar.	Czc-Recent	Climat. Ecol.	Popofsky A. 1920
Antar. Atlantic	Plio-Pleist. Neog. Quater.	Strat. Antar.	Abelmann A. & Gersonde R. 1988
Antar. Pacif.S.	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1979b
Antar. SE.Indian Oc.	Quater.(L.Pleist.)	Environ. Biogeog.	Dow R. L. 1978
Antar.Indian Oc.	Quater.	Taxon. Skelet.	Petrushevskaya M. G. 1975c
Antar.S.	Quater.	Taxon.	Boltovskoy D. & Vrba A. 1988
Antarct.	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1974
Antarctic	Quater.	Earth Rotation Cyclicity	Hays J.D. *et al.* 1976
Antarctic	Quater.	Climat. Extinct.	Hays J. D. & Donahue J. G. 1972
Antarctic		Biostrat DSDP	Chen P. H. 1975
Antarctic	Oligoc.-Neog.	Taxon. Strat. DSDP	Chen P. H. 1974
Antarctic	Quater.	Climat. Biozon.	Hays J. D. & Opdyke N. D. 1967
Arctic	Quater.	Taxon. N.Sp.	Hulsemann K. 1963
Arctic Pacif.? Boreal	Paleog.-Recent		Kozlova G. E. 1984a
Asia Australia	Czc? Mzc?	Sedim.	Kobayashi T. 1944
Asia Centr.Japan	Miocene	Taxon.	Tanaka H. *et al.* 1983
Asia China		Taxon. N.Sp.	Xinghui S. 1982
Asia China	Czc	Biol.	Xinghui S. & Zhiyuan T. 1985
Asia China	Mzc Czc	Taxon. Skelet. Evolut.	Tan Z.-Y. Su S.-H. 1981
Asia China Gyangze Xizang		Plankt.	Wang Yujing & Sheng Jinzhang 1982
Asia China Himalaya Tibet Xizang	Czc		Wu Hao-ruo 1980
Asia China Sea E.	Czc Quater.	Environ. Taxon.	Chen-Wenbin-Wang Baoyong 1982
Asia China Xisha Islands	Czc	Taxon. Skelet.	Zhiyuan T. & Xinghui S. 1981
Asia E.China Sea	Czc		Tan Zh. Su X. 1982
Asia E.China Sea		Strat. Geogr.	Zhiyuan T. *et al.* 1978
Asia E.China Sea	Czc	Strat.	Zhiyuan T. & Tsorun T. 1976
Asia Europe ex-Ussr pre-Causasus	Paleoc.-Eoc.		Lipman R. Kh. 1984b
Asia ex-Ussr N.Sakhalin	Neog.		Runeva N. P. 1984
Asia Himalaya Tibet Ladakh	Eoc.	Strat.	Colchen M. *et al.* 1987
Asia Indones. S.China Sea	Czc Quater.		Ling H. Y. 1972
Asia Japan	Czc	Biozon. Strat.	Kitazato H. 1975
Asia Japan	Czc Mzc Pzc	General	Kimura T. 1944
Asia Japan	Czc Mzc		Kobayashi T. & Kimura T. 1944
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Asia Japan	Neogene		Sugano K. & Nakaseko K. 1971

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Asia Japan	Mioc.-Quater.	Strat.	Nakaseko K. 1956
Asia Japan	Neogene		Sugano K. & Nakaseko K. 1973
Asia Japan	Neogene		Sugano K. & Nakaseko K. 1972
Asia Japan	Mzc? Czc?	Sedim.	Sugano K. 1986
Asia Japan	Mioc.	Strat.	Nakaseko K. 1954
Asia Japan	Mzc Czc	Review	Sugano K. 1975
Asia Japan	Czc		Ling H. Y. & Kurihara K. 1972
Asia Japan	Mioc.	Strat.	Nakaseko K. 1955
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Asia Japan	Mioc.	Strat.	Nakaseko K. & Nishimura A. 1974
Asia Japan	Neogene	Strat.	Nakaseko K. & Sugano K. 1973
Asia Japan	Neogene	Strat.	Nakaseko K. *et al.* 1972 a, b
Asia Japan		Geol. Strat.	Nakaseko K. *et al.* 1979a
Asia Japan	Czc	Strat.	Nakaseko K. *et al.* 1979b
Asia Japan	Czc		Takayanagi Y. *et al.* 1978
Asia Japan	Mioc.	Taxon. Strat.	Nakaseko K. *et al.* 1982
Asia Japan	Mioc.-Quater.	Strat.	Nakaseko K. & Sugano K. 1972
Asia Japan	Czc	Strat.	Nakaseko K. 1979
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Asia Japan	Mioc.-Quater.	Strat.	Nakaseko K. & Chiji M. 1964
Asia Japan	Cret.-Czc	Strat.	Nakaseko K. *et al.* 1965
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Asia Japan	Plioc.-Quater.		Nishimura A. & Yamauchi M. 1984
Asia Japan	Mioc.-Quater.	Strat.	Nakaseko K. 1959b
Asia Japan			Okada H. *et al.* 1982
Asia Japan	Czc		Sugano K. *et al.* 1980
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Asia Japan	Neog. Quater.		Sugano K. & Nagata K. 1978
Asia Japan	Mioc.-Quater.	Strat.	Nakaseko K. 1963
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Asia Japan C.Pacif. Amer.N. Calif.	Mioc.-Plioc.	Strat.	Nagata K. 1982b
Asia Japan	Czc	Skelet.	Nishimura H. 1986
Asia Japan E.Hokkaido		Biostrat. Preserv. Diagen.	Nagata K. 1986
Asia Japan Equat.Pacif.		Strat. Plankt.	Takayanagi Y. *et al.* 1979 a, b
Asia Japan Hokkaido	Mioc.	Strat.	Nagata K. & Ichinoseki T. 1982
Asia Japan Hokkaido	Mioc.-Quater.	Strat.	Nagata K. 1979
Asia Japan Honshu	Mioc.	Biozon.	Oda M. *et al.* 1983
Asia Japan Honshu	Czc	Strat.	Iijima A. *et al.* 1981
Asia Japan NE.Honshu		Strat.	Amano K. 1980
Asia Japan Pacif.		DSDP56 Strat.	Barron J. A. *et al.* 1980
Asia Japan Sendai	Czc?		Oda M. & Sakai T. 1977
Asia Japan Shimanto	Czc	Taxon.	Ishikawa T. 1982
Asia Japan W.Hokkaido		Strat.	Nagata K. 1982a
Asia Japan	Oligoc.-Neog.		Ling H. Y. 1987
Asia Japan.C.	Neog.		Sugano K. 1982a
Asia Japan.C.		History Review	Sugano K. 1982b

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Asia Japan.SW.	Czc Mzc		Ishida S. 1979
Asia Japan.SW. Shikoku			Yamasaki T. 1987
Asia Japan.SW. Maizuru Gr.		Biostrat.	Nishimura K. & Ishiga H. 1987
Asia Pacif.			Sakai T. *et al.* 1981
Asia Pacif. Celebes Indones.			Hinde G. J. 1917
Asia SE.Middle Tadzhikistan	Paleog. Eoc.		Chediya D. M. *et al.* 1971
Atlant. Norway	Quater.	Skelet. Taxon.	Bjørklund K. R. 1974a
Atlant.	Mzc?	Taxon.	Ehrenberg C. G. 1854
Atlant.	Quater.	Sedim.	Caulet J. P. & Clocciatti M. 1975
Atlant.	Quater.	Environ. Biogeog.	Bjørklund K. R. & Swanberg N. R. 1987
Atlant.	Quater.		Kozlova G. E. 1980
Atlant.	Recent	Biol.	Kleijne A. 1987
Atlant.	Cret.-Quater.	Strat. DSDP2	Cita M.B. *et al.* 1970
Atlant.	Czc	Biogeog.	Casey R. E. & McMillen K. J. 1977
Atlant.	Quater.	Strat. Climat.	Morley J. J. & Shackleton N. J. 1978
Atlant. Açores	Czc-Recent	Plankt.	Muzavor S. N. X. 1981
Atlant. Amer.C. Carib.	Quater.	Environ. Biogeog.	Casey R. E. 1971a
Atlant. Amer.C. Carib.	Recent	Biol.	Swanberg N. R. *et al.* 1986 a, b, c
Atlant. Amer.C. Carib. Gulf Mexico	Quater.	Ecol. Biogeog.	Casey R. E. *et al.* 1979a
Atlant. Amer.C. Carib. Gulf-Coast	Quater.	Environ. Ecol. Current Plankt.	Casey R. E. *et al.* 1981
Atlant. Amer.C. Carib. S.Texas	Quater.	Ecol. Environ. Current	Leavesley A. *et al.* 1978
Atlant. Boreal Norway	Quater.	Current Biogeog. Sedim.	Jansen E. & Bjørklund K. R. 1985
Atlant. Boreal Norway		Strat. DSDP38	Dzinoridze R. N. et al. 1976
Atlant. Boreal Norway Greenland	Neog.-Quater.	Evolut. Strat.	Goll R. M. & Bjørklund K. R. 1980
Atlant. Boreal Norway Greenland		Taxon. N.Sp.	Goll R. M. & Bjørklund K. R. 1985
Atlant. Carib.	Quater.	Environ. Ecol.	Casey R. E. 1971b
Atlant. Carib. Barbados			Ehrenberg C. G. 1846
Atlant. Carib. Blake Bahama	Czc	DSDP44	Weaver F. M. & Dinkelman M. G. 1978
Atlant. Europe	Czc Mzc		Swain F. M. 1977
Atlant. Rochall Plateau	Mioc.	DSDP81 Strat.	Westberg-Smith M. J. & Riedel W. R. 1984
Atlant. S.Brasil	Czc		Kotzian S. B. & Eilert V. P. 1985
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Atlant. Antar.	Neog.	Biostrat.	Abelmann A. 1988
Atlant.E. Angola	Quater.	Biogeog. Environ.	Bjørklund K. R. & Jansen J. H. F. 1984
Atlant.E. Morocco	Mioc.	DSDP50 Strat.	Westberg M. J. *et al.* 1980
Atlant.E. NW.Africa	Quater.	Biogeog. Ecol.	Labracherie M. 1980a
Atlant.E. NW.Africa	Quater.	Current	Labracherie M. 1980b
Atlant.E.Tropic.		DSDP41 Strat. Taxon.	Johnson D. A. 1978
Atlant.N. Boreal Norway	Quater.	Biol. Skelet. Plankt.	Swanberg N. R. & Bjørklund K. R. 1987b
Atlant.N. Boreal Norway	Recent	Plankt. Ecol. Environ.	Swanberg N. R. & Bjørklund K. R. 1986
Atlant.N. Boreal Norway	Quater.	Biol. Plankt. Ecol.	Swanberg N. R. & Bjørklund K. R. 1987a
Atlant.N.	Quater. Recent	Biogeog.	Kleijne A. 1984
Atlant.N.	Quater.	N.Sp. Biogeog. Skelet.	Bjørklund K. R. 1976a
Atlant.N.	Quater.	Biogeog. Sedim.	Goll R. M. & Bjørklund K. R. 1971
Atlant.N.		Strat. Taxon.	Riedel W. R. 1957a
Atlant.N.	Czc	DSDP94	Westberg-Smith M. J. *et al.* 1986
Atlant.N.	Czc-Quater.	Taxon. Plankt. Skelet.	Petrushevskaya M. G. 1969
Atlant.N. Antar. Pacif.N.	Neog.		Lombari G. & Lazarus D. B. 1988
Atlant.N. Boreal Norvegian Sea		Strat.	Bjørklund K. R. 1976b
Atlant.N. Boreal Norway	Quater.		Jörgensen E. 1900
Atlant.N. Boreal Norway		DSDP Taxon.	Petrushevskaya M. G. & Kozlova G. E. 1979

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Atlant.N. Boreal Norweg.-Greenland	Quater.	Taxon.	Petrushevskaya M. G. & Bjørklund K. R. 1974
Atlant.N. Boreal Norwegian Sea	Quater.	Climat. Environ.	Bjørklund K.R. *et al.* 1979
Atlant.N. Boreal Norwegian Sea		DSDP38	Jouse A. P. *et al.* 1979
Atlant.N. Boreal Norwegian Sea	Eoc.	Taxon. N.Sp.	Bjørklund K. R. & Kellogg D. E. 1972
Atlant.N. Boreal Norweg.-Greenl. Sea	Quater.	Climat. Environ.	Bjørklund K. R. & Goll R. M. 1979a
Atlant.N. N.Sea	Recent	Strat.	Bjørklund K. R. 1985
Atlant.N. N.Sea (Skagerrak)	Quater.	Environ. Sedim.	Bjørklund K. R. *et al.* 1985
Atlant.N. N.Sea (Skagerrak)	Quater.	Strat.	Bjørklund K. R. 1985
Atlant.N. N.Sea	Quater.	Strat. Biogeog.	Bjørklund K. R. 1983
Atlant.N. Norwegian-Greenland	Quater	Evolut.	Kozlova G. E. & Petrushevskaya M. G. 1979
Atlant.N. Reykjanes Ridge	Czc	Strat. Taxon. DSDP49	Ling H. Y. 1979
Atlant.N. W.Norway Biogeog.	Recent	Season. product. Climat.	Bjørklund K. R. 1974b
Atlant.NE.	Quater.	Current	Labracherie M. & Moyes J. 1978
Atlant.NE.	Neog.	Taxon. Strat. DSDP48	Sanfilippo A. & Riedel W. R. 1979
Atlant.NE. Mediter.	Cret.-Quater.	DSDP13 Taxon. Strat.	Dumitrica P. 1973a
Atlant.NE. S.Norwegian Sea	Quater.	Biogeog. Ecol.	Labracherie M. 1978
Atlant.NW.	Czc	DSDP 93	Nishimura A. 1987
Atlant.S.		Environ. Ecol.	Boltovskoy D. 1980
Atlant.S.	Quater.	Sedim. Biogeog.	Goll R. M. & Bjørklund K. R. 1974
Atlant.S.	Czc-Quater.	Biogeog. Ecol. Climat.	Morley J. J. 1979
Atlant.S. Antar. S.W.Indian. Oc.		Biogeog. Current Sedim. Environ.	Lozano J. A. & Hays J. D. 1976
Atlant.SW.		Biogeog.	Boltovskoy D. 1981a, b
Atlant.SW.	Quater.	Recent Biogeog.	Boltovskoy D. 1978a, b
Atlant.SW.	Quater.		Boltovskoy D. & Riedel W. R. 1980
Atlant.SW.	Recent	Plankt. Biogeog.	Boltovskoy D. 1982
Atlant.SW.	Recent	Biogeog. Current Environ.	Boltovskoy D. 1986
Atlant.SW. Antar.	Quater.		Eilert V. P. 1985
Atlant.SW.	Recent	Plankt. Biogeog.	Boltovskoy D. 1979
Atlant.W Carib. Amer.C.Barbados	Eoc.	Evolut.	Sanfilippo A. *et al.* 1985a, b
Atlant.W. Amer.C. Carib. Mexic.	Quater.	Ecol. Biogeog. Sedim. Plankt.	McMillen K. J. & Casey R. E. 1978
Atlant.W. Amer.C. Carib. Mexico	Quater.	Ecol. Biogeog. Preserv.	McMillen K. J. 1977a
Atlant.W. Amer.C. Carib. Mexico	Quater.	Ecol. Biogeog. Preserv. DSDP66	McMillen K. J. 1982
Atlant.W. Amer.C. Carib. Mexico	Czc Quater.	Ecol. Biogeog. Preserv.	McMillen K. J. 1977b
Atlant.W. Barbados Antilles	Czc	DSDP	Renz G. W. 1984
Atlant.W. Carib.	Neog.	Taxon. Strat.	Sanfilippo A. & Riedel W. R. 1976
Atlant.W. Carib. Gulf Mexico	Plio-Quater.	Plankt. Taxon. Environ.	Casey R. E. *et al.* 1979c
Atlant.W. Gulf Mexico	Quater.	Ecol. Sedim.	Casey R. E. *et al.* 1979b
Atlant.W. Gulf Mexico Carib. Calif.	Czc Quater.	Strat. Environ. Plankt. Ecol.	Wigley C. R. 1982
Atlant.W. Gulf Stream	Recent	Biol.	Swanberg N. R. & Anderson R. O. 1981
Atlant.W.Tropic.	Quater.	Flux Sedim. Current Preserv. Skelet.	Takahashi K. & Honjo S. 1983
Atlant.W.Tropic.	Quater.	Flux Sedim. Current Preserv.	Takahashi K. & Honjo S. 1981 a, b
Atlantic	Recent	Ecol. Biol.	Swanberg N. R. & Harbison G. R. 1980
Atlantic	Czc-Quater.	Strat.	Morley J. J. & Shackleton N. J. 1978
Atlantic	Czc	Taxon. DSDP	Riedel W. R. 1971a
Atlantic Antar.	Plio-Pleist. Neog.	Strat. Antar.	Abelmann A. & Gersonde R. 1988
Atlantic.S.	Quater.	Biogeog. Ecol. Climat.	Morley J. J. & Hays J. D. 1979a
Banda		Taxon. N.Sp. Sedim.	Harting P. 1863
Calif. El Nino	Quater.	Climat. Current Environ. Ecol.	Casey R. E. *et al.* 1987
Eurasia ex-Ussr	Paleog.	Boreal Strat.	Lipman R. Kh. 1985
Europe Austria	Mioc.	Taxon.	Bachmann A. *et al.* 1963
Europe Belgium Ieper	Eoc.		Willems W. 1981
Europe Carpathian Poland	Mioc.		Barwicz-Piskorz W. 1978

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Europe France (Paris Bas.) Belgium	Czc	Sedim. Petro.	Cayeux L. 1897
Europe Italy Calabria	Plio-Quater.	Tripoli Strat. Sedim.	Guerrera F. 1881
Europe Italy Calabria	Plioc.		Sanfilippo A. 1988
Europe Italy Sicily Tripoli	Mioc.		Stohr E. 1880
Europe Italy Sicily Zancle	Plioc.	Taxon. Strat.	Riedel W. R. *et al.* 1974
Europe Medit.	Quater.	Preserv. Sedim. Taxon.	Caulet J. P. 1972
Europe Medit.	Recent	Plankt. Climat. Season Ecol.	Massera Bottazzi E. & Andreoli M. G. 1977 a, b
Europe Medit.	Czc Recent	Biogeog. Current Environ.	Massera Bottazzi E. *et al.* 1986
Europe Medit.	Czc Recent	Plankt. Environ. Ecol.	Massera Bottazzi E. *et al.* 1984
Europe Medit. Tirreno	Quater.	Taxon.	Poluzzi A. 1982
Europe N.France	Eoc.	Sedim.	Cayeux L. 1891
Europe.E. Brno-Kralovo	Mioc.	Taxon	Slama P. 1982
ex-Ussr	Czc		Goltman E. V. 1970
ex-Ussr	Eoc.	Taxon. N.Sp.	Lipman R. Kh. 1969
ex-Ussr	Paleogene Czc Eoc.		Lipman R. Kh. 1972
ex-Ussr	Eoc.	Biozon.	Zagorodnyuk V. I. 1981
ex-Ussr	Paleogene	Strat.	Lipman R. Kh. 1975b
ex-Ussr Crimea Minor Asia	Ecol.		Tchedya D. M. 1981
ex-Ussr Don River N.Emba	L.Eoc.	Strat.	Zagorodnyuk V. I. 1969
ex-Ussr General	Czc Mzc Pzc		Lipman R. Kh. 1976
ex-Ussr Kamtchatka			Runeva N. P. 1975
ex-Ussr Kamtchatka		Taxon. N.Sp.	Bailey J. W. 1856
ex-Ussr Kuban	Paleoc.-Eoc.	Taxon. N.Sp.	Borisenko N. N. 1960a
ex-Ussr Kuban	Eoc.	Taxon.	Borisenko N. N. 1960b
ex-Ussr Mid.Asia.	Czc Mzc		Tschedia D. M. 1984
ex-Ussr N.Sakhalin	Mioc.		Kozlova G. E. 1960
ex-Ussr NE.Azherbaidjan	Eoc.	Strat. Evolut.	Mamedov N. A. 1975
ex-Ussr Pacif.	Quater.		Strelkov A. A. & Reschetnyak V. V. 1971
ex-Ussr Paleoc. W.Kuban	Eoc.	Taxon. N.Sp.	Borisenko N. N. 1958
ex-Ussr Pre-Aral	Eoc.	Taxon. N.Sp	Lipman R. Kh. 1975a
ex-Ussr Pre-carpath.	Mioc.		Runeva N. P. 1969
ex-Ussr Pricaspian	Czc Eoc.	Strat.	Zagorodnyuk V. I. 1975
ex-Ussr Priscaspia.	Eoc.	Strat.	Nikitina I. P. & Zagorodnyuk V. I. 1981
ex-Ussr S.Sakalina W.Kamtchatka.	Mzc?		Runeva N. P. 1981
ex-Ussr Sakhalin	Neog.	N.Sp. Biostrat.	Popova I. M. 1988
ex-Ussr Shemakh.-Kobyst. Azerbaid.	Eoc.	Strat.	Mamedov N. A. 1973a
ex-Ussr Siberia	Czc Mzc		Lipman R. Kh. 1960
ex-Ussr Sikhote-Alinj			Eliseeva V. K. *et al.* 1976
ex-Ussr Tadjiksk.	Czc	Strat.	Goltman E. V. 1981a
ex-Ussr Tadzhiksk	Maastr.-Quater.		Goltman E. V. 1973
ex-Ussr Tadzhikski	Czc		Goltman E. V. 1971
ex-Ussr Tadzhikskoi		Strat.	Goltman E. V. 1975
ex-Ussr Tadzhikskoi	Quater.	Strat.	Goltman E. V. 1981b
ex-Ussr Turgay Pre-Aral.		Biogeog.	Lipman R. Kh. & Khokhlova A. I. 1964
ex-Ussr Turkmen.	Czc? Mzc?	Strat.	Moksyakova A. M. 1965
ex-Ussr Turkmen.	L.Eocene	Strat.	Moksyakova A. M. 1969
ex-Ussr Ukrain. Carpath.	Paleog.		Lozynyak P. Yu. 1985
ex-Ussr Urals		Skelet.	Amon E. & Kovaltchuk A. I. 1988
ex-Ussr W.Pre-Caucasus	Eoc.		Krasheninnikov V. A. 1960
ex-Ussr W.Siberian	L.Eoc.	Taxon. N.Sp.	Gorbovetz A. N. 1972
ex-Ussr W.Siberian	Paleog.-Recent	Biogeog.	Gorbovetz A. N. *et al.* 1972
ex-Ussr W.Siberian	L.Eocene		Kozlova G. E. & Gorbovets A. N. 1966

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ex-Ussr W.Turkmen.	L.Eocene		Moksyakova A. M. 1961
ex-USSR Crimea Tadzhiksk	Paleog. Eoc.		Chediya D. M. & Chediya I. O. 1973
ex-USSR N.Kamtchatka Bering S.	Paleog.		Averina G. Y. 1988
Faroe Channel	Quater.	Taxon.	Haeckel E. 1882
General	Quater.	Taxon.	Haeckel E. 1862
General	Czc-Quater.	Biol. Skelet.	Haeckel E. 1866
General	Mzc Czc	Taxon. Skelet.	Petrushevskaya M. G. 1979a
General	Mzc Pzc	Taxon.	Petrushevskaya M. G. 1984
General	Czc Mzc?		Zhamoida A. I. 1984
General		Taxon.	Riedel W. R. 1971b
General	Mzc Czc Quater.	Taxon.	Petrushevskaya M. G. 1975d
Global	Quater.	Ecol. Environ. Biogeog.	Casey R. E. 1977
Global	Czc Quater.	Biogeog. Ecol. Evolut.	Casey R. E. 1982
Global		Biogeog. Current Environ.	Casey R. E. *et al.* 1982
Indian	L.Eoc.	Taxon. Strat. Biogeog. Oc.	Goll R. M. & Caulet J. P. 1985
Indian Antarct.	Czc-Recent	Taxon. Plankt.	Petrushevskaya M. G. 1971c
Indian E.Arabia Peru	Mioc.-Recent	ODP	Caulet J. P. & Nigrini C. 1988
Indian Oc.	Neog.	Environ. Ecol. Season Current	Caulet J. P. 1977
Indian Oc.	Pleistocene	Biostr.	Caulet J. P. 1986
Indian Oc.	Neog.	Sedim. Environ.	Caulet J. P. 1978
Indian Oc.		Strat. Taxon. DSDP22	Johnson D. A. 1974a
Indian Oc.		Sedim. Mineral. Mn	Leclaire L. *et al.* 1976
Indian Oc.	Czc-Quater.	Taxon. Biogeog. Current Plankt.	Petrushevskaya M. G. 1973
Indian Oc. Antar.	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1977b
Indian Oc. Antar.		Taxon. Plankt.	Petrushevskaya M. G. 1971a
Indian Oc. Antar.	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1977a
Indian Oc. Antarctic	Quater.	Taxon. DSDP29	Petrushevskaya M. G. 1975c
Indian Oc. Atlant.		Plankt.	Nigrini C. A. 1967
Indian Oc. Indon. Burma Andama Isl.	Czc	Strat.	Jacob K. & Shrivastava R. N. 1952
Indian Oc. Pacif.Tropical	Neog.	Evolut. Strat.	Caulet J. P. & Nigrini C. 1988
Indian Oc.C.	Plioc. Quater.	Strat.	Caulet J. P. 1979
Indian Oc.E.	Quater.	Strat. Biogeog.	Johnson D. A. & Nigrini C. 1982
Indian Oc.S.	Paleoc.-Eocene		Caulet J. P. 1988
Indian Oc.S.	Neog.	Skelet. Ecol. Environ. Climat.	Granlund A. H. 1986
Indian Oc.S.	Quater.	Climat. Strat.	Caulet J. P. 1982
Indian Oc.S.	Neog.	Skelet. Environ. Ecol. Climat.	Granlund A. H. 1984
Indian Oc.S.		Taxon. Strat. DSDP26	Riedel W. R. & Sanfilippo A. 1974b
Indian Pacif.	L.Neog.-Quater.	N.Sp. Phylog.	Nigrini C. & Caulet J. P. 1988
Indian W.Gulf Aden		Taxon. Strat. DSDP24	Riedel W. R. & Sanfilippo A. 1974a
Indian.S.	Paleoc.	Ecol. Climat.	Morley J. J. 1989
Indian.W.	Neog.	Taxon. Strat. DSDP25	Sanfilippo A. & Riedel W. R. 1974b
Indian.W. Gulf Aden	Neog.	Taxon. Strat. DSDP24	Sanfilippo A. & Riedel W. R. 1974a
Indian.W. Oc.	Quater.	Biogeog.	Johnson D. A. & Nigrini C. 1980
Indian.W. Oc. Arabian Sea	Quater.	Strat. Taxon.	Nigrini C. A. 1974
Indian.W. Oc. E.Somaly Basin	Quater.	Sedim.	Caulet J. P. *et al.* 1988
Indonesia	Czc? Mzc?	Strat. Taxon.	Tan Sin-Hok 1931
Medit.	Czc	Taxon. N.Sp.	Haeckel E. 1861
Medit.	Czc	Taxon. N.Sp.	Haeckel E. 1860
Medit.	Czc-Quater.	Acanth.	Muller J. 1858
Medit.	Czc-Recent	Acanth.	Muller J. 1856
Medit.	Neog.	Taxon. Strat.	Sanfilippo A. *et al.* 1973
Medit.	Neog.	Taxon. Strat. DSDP42A	Sanfilippo A. *et al.* 1978

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Medit. Pacif.	Czc	Biogeog. Taxon.	Caulet J. P. 1971
Medit. Pacif. Amer.C. Carib. Gulf Mex.	Paleoc.-Neog.	Taxon. Strat. DSDP10	Sanfilippo A. & Riedel W. R. 1973
Medit. Pacif.W.	Neog.	Taxon. Strat.	Sanfilippo A. 1971
Medit. Tethys		Taxon.	Caulet J. P. 1974
Middle-East Israel	Eoc.		Reiss Z. 1952
Pacif.	Czc-Quater.	Sedim. Preserv.	Hurd J. D. 1973
Pacif.	Quater.	Preserv.	Hurd D. C. & Takahashi K. 1983
Pacif.	Czc	Strat. DSDP55	Koizumi I. *et al.* 1980
Pacif.	Czc-Quater.	Strat. Taxon. DSDP30	Holdsworth B. K. 1975
Pacif.	Plioc.-Quater.	Evolut. Taxon.	Kellogg D. E. 1976
Pacif.		Climat. Biozon.	Hays J. D. *et al.* 1972
Pacif.	Paleoc.Eoc.	Taxon. DSDP21 Strat.	Dumitrica P. 1973
Pacif.	Plio-Quater.	Strat. Climat.	Hays J. D. *et al.* 1969
Pacif.	Czc	Strat. Taxon.	Riedel W. R. & Funnell B. M. 1964
Pacif.	Mzc Czc	Strat. DSDP	Riedel W. R. 1981
Pacif.	Paleoc.-Eoc.	DSDP S.384	Nishimura A. 1986
Pacif.	Mioc.-Quater.	Strat.	Saito T. *et al.* 1975
Pacif.		DSDP56, 57	Reynolds R. A. et al. 1980
Pacif.	Mioc.	DSDP Strat.	Westberg M. J. & Riedel W. R. 1978
Pacif.	Czc-Quater.	Biogeog. Ecol. Climat.	Moore T. C. 1978
Pacif. Amer.C. Carib. Gulf Mex. Medit.	Paleoc.-Neog.	Taxon. Strat. DSDP10	Sanfilippo A. & Riedel W. R. 1973
Pacif. Amer.N. Calif.	Quater.	Strat. DSDP65	Benson R. N. 1983a
Pacif. Atlant. Antar.	Plioc.	Strat. Climat.	Keany J. 1976
Pacif. Australia		Sedim. Environ.	Fenton M. W. *et al.* 1982
Pacif. Australia		Sedim.	Hinde G. J. 1893
Pacif. Carib. Atlant.		Taxon. Evolut.	Goll R. M. 1968
Pacif. Carib. Atlant.		Taxon. Evolut.	Goll R. M. 1969a
Pacif. Equatorial		Strat.	Johnson D. A. & Parker F. L. 1972
Pacif. Equatorial	Quater.	Biogeog. Climat.	Johnson D. A. & Knoll A. H. 1974
Pacif. Indian Oc.	Paleog.	Environ.	Sancetta C. 1979
Pacif. Indones. Bangka	Czc Mzc	Sedim.	Hinde G. J. 1897
Pacif. Indones. Celebes			Hojnos R. 1934
Pacif. Indonesia Philippine Sea	Paleog.-Neog.	Biozon. DSDP59	Theyer F. & Lineberger P. 1981
Pacif. Mariana	Cret.-Czc-Quater.	Strat. DSDP60	Kling S. A. 1982
Pacif. Okhotsk Sea		Biogeog.	Kruglikova S. B. 1975
Pacif. Tahiti		Strat. Plankt.	Takayanagi Y. *et al.* 1982
Pacif. tropical	Czc	Strat. Taxon.	Friend J.K. & Riedel W. R. 1967
Pacif.C.		Sedim. Biogeog. Environ.	Leinen M. 1979
Pacif.C.	Quater.	Plankt. Sedim. Ecol. Biogeog. Preserv.	Renz G.W. 1976
Pacif.C. Equator.	Mioc.	Strat.	Blueford J. R. 1982
Pacif.C. Equatorial	Quater.	Environ. Sedim.	Blueford J. R. 1980
Pacif.C. Tropical	Quater.	Taxon. N.Sp.	Deflandre G. 1972
Pacif.Cent.	Quater.	Taxon. Plankt.	Petrushevskaya M. G. 1971b
Pacif.E.	Recent	Plankt. Oceano.	Boltovskoy D. & Jankilevich S. S. 1985
Pacif.E.	Quater.	Sedim.	Johnson D. A. 1974
Pacif.E.		Strat. DSDP16	Bukry D. *et al.* 1973
Pacif.E.	Plioc.-Quater.	Taxon. Strat. DSDP54	Goll R. M. 1980
Pacif.E.	Quater.	Environ. Current Strat.	Romine K. & Moore T. C. 1981
Pacif.E. Amer.C. Carib.	Neog.	Taxon. Strat. DSDP68	Riedel W. R. & Westberg J. M. 1982
Pacif.E. Amer.C. off Guatemala	Mioc.	DSDP67 Strat.	Westberg M. J. & Riedel W. R. 1982
Pacif.E. Amer.S. Peru	Czc-Quater.	Current Environ.	Molina-Cruz A. 1984
Pacif.E. Calif. Peru	Recent	Plankt. Oceanol. Upwell. Ecol.	Pisias N. G. *et al.* 1986

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Pacif.E. off Peru	Mioc.-Quate	Stratig.	De Wever P. *et al.* 1995
Pacif.E. off Peru	Neog.	Strat.	De Wever P. *et al.* 1990
Pacif.E. Peru	Mioc.	Sedim. Environ.	Marty R. C. *et al.* 1987
Pacif.E. Peru E.Arabia	Mioc.-Recent	ODP	Caulet J. P. & Nigrini C. 1988
Pacif.E. Peru Nazca		Ecol. Current Environ. DSDP34	Sachs H. M. 1976
Pacif.E.tropic.		Plankt.	Nigrini C. A. 1968
Pacif.Equat.	Quater.	Strat. Plankt.	Nigrini C. A. 1971
Pacif.N. Bering Sea	Quater.		Ling H. Y. *et al.* 1971
Pacif.N. SE.Bering	Quater. Recent	Sedim. Product.	Banahan S. & Goering J. J. 1986
Pacif.N.		Strat. Evolut.	Hays J. D. 1970
Pacif.N.	Mzc Quater.	Sedim. Preserv.	Erez J. *et al.* 1982
Pacif.N.	Czc	Biol. Sedim.	Kruglikova S. B. 1973
Pacif.N.		Ecol. Current Environ.	Sachs H. M. 1973
Pacif.N.	Quater.	Plankt.	Nigrini C. A. 1970
Pacif.N.		Taxon. Evolut. Skelet. Ecol.	Sachs H. M. & Hasson P. F. 1979
Pacif.N. (boreal-subtrop.)	Czc Quater.	Environ. Biogeog.	Kruglikova S. B. 1977
Pacif.N. Amer.C. Calif.	Neog.	DSDP63	Wolfart R. 1981
Pacif.N. Antar. Atlant.N.	Neog.		Lombari G. & Lazarus D. B. 1988
Pacif.N. Navarin Bering Sea	Quater.	Biogeog. Environ.	Blueford J. R. 1983
Pacif.N. S.Bering Sea	L.Czc	Diagen. Sedim.	Hein J. R. *et al.* 1978
Pacif.N.		Strat.	Quinterno P. & Theyer F. 1979
Pacif.N.Centr.	Recent	Ecol. Distrib.	Kling S. A. 1979
Pacif.NE.	Czc	DSDP18	Kling S. A. 1973
Pacif.NE.			Ling H. Y. 1966
Pacif.NE.	Quater.	Preserv.	Kadko D. *et al.* 1983
Pacif.NE.	Czc-Quater.	Current	Moore T. C. 1973b
Pacif.NE.	Recent	Sedim. Oceanog.	Yamauchi M. 1986
Pacif.NW.	Czc	Strat. DSDP55	Ling H. Y. 1980
Pacif.NW.		DSDP56	Sakai T. 1980
Pacif.NW.	Czc	DSDP56,57	Reynolds R. A. 1980
Pacif.NW.	Plioc.-Recent	Climat. Environ.	Morley J. J. 1987
Pacif.NW. Sea Okhotsk	Czc Quater.		Ling H. Y. 1974
Pacif.NW. Kamtchat. Kuroshio	Czc	Sedim. Current	Popova I. M. 1986
Pacif.S.	Mzc Czc	Plankt. Geogr.	Stevens 1980
Pacif.S.	Plioc.-Quater.		Lukanina I. V. 1985
Pacif.SE.	Quater.	Environ. Biogeog. Current Ecol.	Molina-Cruz A. 1977
Pacif.SE. Antar.	Czc	DSDP35	Weaver F. M. 1976
Pacif.Tropic. Indo.	Neog.	Strat.	Johnson D. A. *et al.* 1987
Pacif.W Saipan Mariana	Eoc.	Strat.	Riedel W. R. 1957b
Pacif.W Tropical	Oligoc.-Mioc.	Taxon.	Riedel W. R. 1959
Pacif.W.		Taxon. Strat. DSDP7	Riedel W. R. & Sanfilippo A. 1971
Pacif.W.	Czc	Strat. DSDP61	De Wever P. 1981
Pacif.W.	Quat	Biogeog. Paleocean. Sedim.	Boltovskoy D. 1987
Pacif.W.	Czc	Taxon.	Riedel W. R. 1952
Pacif.W. Philip. Indian Oc. Indon. Pacif.		DSDP58	Sloan J. 1980
Pacif.W.	Paleog.-Quater.	Strat.	Sanfilippo A. *et al.* 1981
Pacif.W.Centr.Equat.		Biozon.	Kobayashi K. *et al.* 1971
Pacif.W.C. Taiwan	Czc Recent	Sedim.	Cheng Y.-N. & Yeh K.-Y. 1989
Pacific		Sedim. Oceanol. Miner.	Baker E. T. *et al.* 1979
Pacific	Neog.	Earth rotation	Hammond R. S. *et al.* 1979
Pacific Antar.S.	Quater.	Skelet.	Boltovskoy D. & Vrba A. 1989
Pacific Centr.		DSDP33 Strat.	Johnson D. A. 1976

LOCATION	AGE	TOPIC	AUTHOR
Pacific Equat.	Mid.Mioc.	Strat. Biozon.	Johnson D. A. & Wick B. J. 1982
Pacific Indian Oc.	Neog.	Environ.	Sancetta C. 1978
Pacific Equat.	Quater.	Sedim. Current Ecol. Environ. Skelet.	Takahashi K. & Ling H. Y. 1980
Pacific Equatorial	Quater.	Strat. Biozon.	Johnson D. A. & Knoll A. H. 1975
Red Sea		Season Environ. Biogeog.	Goll R. M. 1969b
Ross Sea	Neog.	Climat. DSDP 274	Robert C. *et al.* 1988
Sicily	E.Plioc.	Taxon. Strat. DSDP	Riedel W. R. & Sanfilippo A. 1978b
Tethys	Czc	Taxon. N.Sp. Evolut.	Dumitrica P. 1983a
Tethys Alps Carpath. Klippen			Hojnos R. 1929
Tethys Carpat. Romania	Mioc. (Torton.)		Dumitrica P. 1968
Tethys Carpath.	Mioc.		Dumitrica P. *et al.* 1975
Tethys Cyprus.	Cret.-Czc	Strat. Environ.	Robertson A. H. F. & Hudson J. D. 1974
Tethys Europe Cyprus	Paleoc.-Eoc.	Biozon.	Khokhlova L. I. E. 1988
Tethys Europe Italy	Mioc.(Torton./ Messin.)-Plioc.	Strat.	Coalongo M. L. *et al.*1979
Tethys Europe Italy	Mioc.	Taxon. N.Sp.	Carnevale P. 1908
Tethys Europe Italy	Mzc Czc	Taxon. N.Sp.	Vinassa de Regny P. E. 1898
Tethys Europe Italy	Czc	Taxon.	Neviani A. 1901
Tethys Europe Italy	Mioc.		Vinassa de Regny P. E. 1900
Tethys Europe Italy Calabria	Czc	Strat.	Seguenza G. 1880
Tethys Europe Italy Napoli Messina	Czc Quater.	Biol.	Cienkowski L. 1871
Tethys Europe Italy Rotti	Czc	Strat. Taxon.	Riedel W. R. 1953
Tethys Europe Italy Sicilia (Tripoli)	Mioc.	Taxon. Strat.	Cocco L. 1905
Tethys Europe Italy Sicily	Mioc.	Taxon.	Dreyer F. 1890
Tethys Europe Paratethys	Mioc.	Environ. Crisis DSDP42	Rogl F. *et al.* 1978
Tethys Europe Slovakia	Mioc.(Badenian)	Taxon. Strat.	Dumitrica P. 1978
Tethys Europe Spain	Mioc.	Environ.	Berggren W. A. *et al.* 1976
Tethys Europe Switzerl.	Mzc Czc	Taxon.	Jaccard F. 1909
Tethys Medit.	Quater.	Environ. Preserv. Anoxia	Bjørklund K. R. & De Ruiter R. 1987
Tethys Oman			Hudson R. G. *et al.* 1954
Tropic.Pacif.	Neog.	Evolut.	Levykina I. E. 1985
Tropical	Recent	Sedim. Preserv. Ecol.	Takahashi K. 1981
Tropical	Recent	Plankt. Sedim.	Takahashi K. 1982
Tropical Pacif.	Mioc.-Quater.	Taxon. Plankt.	Nigrini C. A. 1977
Valdivia	Quater.	Taxon. N.Sp. Biogeog. Skelet.	Haecker V. 1907
W.Norway Fjord	Quater.	Sedim. Environ.	Aarseth I. B. *et al.* 1975
World	Czc Mzc		Premoli-Silva I. *et al.* 1976
World Ocean.		Taxon. Skelet.	Petrushevskaya M. G. 1981b
Zealand SE.Otago		New sp.	Benson W. N. & Chapman F. 1938

TABLE 2. — List of publications dealing with Cenozoic strata of the Russian platform. Each publication has a number which corresponds to that on figures 6-14. For each publication the age, region, longitude and latitude, subject of investigation, paleoenvironment and other involved fossil groups is given.

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
1 Amon & Kovaltchuk 1988	Pg Paleocene Eocene	Eastern Ural Turgay	62°30´1-65°00´1E 48°00´1-50°00´1N	Radiolarian zonation established by Lipman for Talitskaya, Serovskaya & Irbitskaya formations.	Talitskaya formation (Paleocene): recrystallized association of Radiolaria, Serovskaya formation (Late Eoc.) shallow water association, Irbitskaya formation (Mid.-Up. Eoc.) pelagic association.	no data
2 Borisenko 1958	Pg Paleocene	Western Kuban Northern Caucasus 1) Beslineevsko-Shedok region 2) Abinsk region (Goryachiy Klyuch) 3) Seversky district (balka Kipashaya)	1) 40°00´1-41°00´1E 44°00´1-45°00´1N 2) 38°30´1-39°30´1E 44°00´1-45°00´1N 3) 38°00-38°30´1E 48°50´1-49°00´1N	Radiolaria from Ilskaya and Psekupskaya formations. 40 new taxa described	Shallow water association	no data
3 Borisenko 1960b	Pg Upper Paleocene	Eastern Kuban 1) Cossak village (boundary between Azovsky and Krasnodarsky district) 2) river M. Zelenchuk (Stavropolsky district)	1) 37°30´1-40°00´1E 46°15´1-47°30´1N 2) 42°00´1-42°30´1E 43°30´1-44°00´1N	Radiolaria from Abasinskaya formation 10 new taxa described	Shallow water association	no data
4 Borisenko 1960a	Pg Lower-Middle Eocene	Western Kuban 1) Babakov George (trubutary of r. Psekups), 2) district Kipuashaya (Gluboky jar) 3) r. Shebsha-Shibika interflow	1) 38°30´1-39°00´1E 44°00´1-45°00´1N 2) 38°00´1-38°30´1E 48°50´1-49°00´1N 3) not found	Radiolaria from Zubzinskaya, Kutaisskaya, Kaluga formations. 15 new taxa described	Shallow water association	no data

5 Chediya Kreidenkov Ashurov 1971	Pg Paleocene	South-eastern Middle Asia 1) Mountain range Peter 1st 2) Khodzha-Kasian 3) Aryk-Tau 4) Istum-Tay 5) Kichik-Donguz	1) not found 2) Khodzha: 70°58´E 40°45´N 3) not found 4) not found 5) not found	Paleocene Radiolaria from Bukharsk layers	Pelagic association	Pelecypods gastropods brachiopods foraminifers ostracods corals
6 Chediya 1973	Pg Eocene	A- Mid.Asia 1) south-western spurs of the Gissarsk mount. range 2) Tadzhiksk depression 3) Fergana B- E.Turkmenia 1) Bukharo-Khiva depression	A- 1) 67°35´-67°45´E 37°30´-37°40´N 2) no precise data 3) 71°19´E;40°23´N B- 1) 60°30´-65°00´E 40°00´-41°00´N	Eocene Radiolari, are studied in thin sections from deposits of Kuberlinsk, Kerestinsk & Kumsk horizons	no data	Radiolaria in rocks analogues to *Globorotalia aequa, G. sububotinae Globigerina aragonensis* etc. forams's zones
7 Chediya D. M. & Chediya I. O. 1973	Pg Late Paleocene-Early Eocene	Crimea Bakhchisaray stratotype section (Simferopol region)	33°00´-33°30´E 44°30´-44°45´N	Radiolaria (bad preserv.) from Kashinskaya formation (Late Paleocene) and Bakhchisaraisky horizon (Early Eocene), no description.	Shallow water association	no data
8 Chediya 1981	Pg Early Eocene Middle Eocene Late Eocene	Middle Asia 1) E. Turkmenia (Bukharo-Khivinsk depression), SE of Mid. Asia (SW spurs of Gissarsk mountain range), Tadzhiksk depression and Fergana 2) Simferopolsky region	1) 64°00´-66°00´E 38°00´-40°00´N 2) 33°00´-33°30´E 44°30´-44°45´N	Radiolaria from 1. Kachinsky, 2. Bakhchisaraisky, 3. Alminsky, 4. Simferopolsky, 5. Bodraksky formations of Simferopolsky region and 1. Suzaksk, 2. Alaisk, 3. Turkestanian, 4. Rishtansk, 5. Isfarinsk horizons of Middle Asia	Alternation of shallow and deep water associations in Simferopolsky region and shallow water associations in Middle Asia	Foram's associations 1. *Acarinia acarinata* 2. *Operculina semirvolita* 3. *Globigerapsis* index zones
9 Gorbunov 1971	Jurassic Cretaceous Paleogene Neogene	Ukraine 1) Kiev (Koryukovka v.) provinces 2) Chernigov (Kholmy v.) prov.	1) 32°10´-32°20´E 51°15´-51°30´N 2) 32°30´-32°40´E 51°45´-51°50´N	Radiolarians of Jurassic, Cretaceous, Paleogene and Neogene summary of the history of the investigations, no description or plate.	no data	no data

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
		3) Poltava (Volynsk) provinces 4) Odessa (Khollodny v.) provinces	3) 34°00´-35°00´E 49°00´-50°00´N 4) 30°30´-31°00´E 46°30´-47°00´N			
10 Kestner 1971	Pg Eocene	Middle Asia, Bukharo- Khivinsk depression (1-5) and SW spurs of the Gissarsk mountain range (6-7) 1) Kushab 2) Khatar 3) Pamuk 4) Lakkent 5) Razak 6) Dekhanobad 7) Toichisai	1) no precise data 2) not found 3) not found 4) not found 5) territory between Khiva (60°49´E;41°25´N) and Bukhara (64°26´E;39°47´N) 6) 66°30´E;38°24´N 7) no precise data	Eocene Radiolaria from Beloglinsk, Kuberlinsk, Kerestinsk horizons	Pelagic association in Upper Eocene shallow water in Lower Eocene	E. Eocene: *Globorotalia-* *aequa* + *G. subbotina.* M. Eocene: *Globorotalia* *aragonensis,* *Acarinina* *crassaformis.* L. Eocene: *Acarinina* *rotundimarginata.*
11 Kestner 1973 a	Pg Oligocene	Ust Yurt Aidzhankos area, Barsakeljmesskij trough	no precise data	Oligocene Radiolaria	Shallow water association	L. Eocene *Lenticulina* *hermanni* + Oligocene *Bolivina* *antegreassa*
12 Kozlova 1984a	Pg Upper Paleocene Lower Eocene	Middle Povolshie, Eastern Ural, Western Siberia 1) Syzran 2) Sengiley 3) Oulianovsk 4) Korshevka 5) Insa	1) 48° 25´-48° 30´E 53° 15´-53° 20´N 2) 48° 45´-48° 48´E 53° 50´-53° 57´N 3) 48° 22´-48° 25´E 54° 19´-54° 20´N 4) 48° 10´-48° 15´E 54° 15´-54° 10´N 5) 46° 20´-46° 21´E 53 °50´-53° 51´N	9 radiolarian assem- blages are given, 7 rad zones established in different formations from Povolshie, E. Ural W. Siberia 4 n. sp. are described	Alternation of shallow and deep water associations of Radiolaria	L. Paleocene diatoms zones:1) *Trinacria* *herbergiana,* 2) *Trinacria* *ventriculosa* 3) *Coscinodiscus* *uralensis* Early Eoc. Z.: 1) *Coscinodiscus* *payeri,* 2) *Pyxilla* *gracilis*
13 Kozlova 1990	Pg Upper Paleocene Lower,	Pre-Caspian region 1) Miyalinskaya-r.Uil v. Miyaly 2) Kamiskolskaya	1) 53° 56´E; 48° 55´N 2) 53° 00´-53° 30´E 48° 30´-49° 30´N	Phylogeny and description of *Axoprunum, Heliodiscus,* *Tripodiscinus,* *Clathrocyclas, Lychnocanum*	no data	no data

	Middle, Upper Eocene	(near Akshatau(?)) 3) Lybenka Voronesh anticline 4) Kantemirovka 5) River Don bassin	3) 54° 13´E; 50° 22´N 4) 39° 52´E 49° 40´N 5) no precise data	& *Phormocyrtis* of Eocene-Upper Paleocene deposits is given The biozonation for boreal province is introduced		
14 Kozlova 1993	Pg Upper Paleocene Lower, Middle, Upper Eocene	1- 9) Voronesh anticline 10- 19) Middle Povolshie 20- 28) Eastern Ural 29- 34) Pre-Caspian 58- 60) W.Siberia 1) Russkie Tishki 2)+3) River Oskol 4) Deresovka 5) Kantemirovka 6) Nikolskoe (near Kalach) 7) Baltinovsk 8) Vorobjevka (n.Vorontsovka) 9) River Mishkova (near Meshkovskaya) 10) Dzhanybek 11) Korshevka 12) Sengiley 13) Insa 14) Balashejka (near Barysh-Kuzovatovo) 15) Kuznetsk 16) Suchanovka 17) Kiselevka+18.r. Alaj +19.Djupa 29) North Emba 30) Emba 31) South Emba 32) Temir 33) Irgiz 34) West Kazachstan, well 125 58) +59) 60) Uspenskaya well	1) 36°44´E;49°51´N 2) 36°44´-37°30´E 49°51´-49°30´N 3) + 4) not found 5) 39°52´E;49°40´N 6) 41°15´-41°80´E 50°10´-50°20´N 7) not found 8) 33°49´E;45°51´N 9) 42°00´-42°10´E 49°40´-49°50´N 10) 46°50´E;49°25´N 11) 12) 13) : =2) 4) 5) 14) 47°09´E;53°40´N 15) 46°35´E;53°08´N 16) see Syzran n°1 17) 18) 19) : 45°00´-47°30´E 52°00´-52°30´N 29) +30) +31) : 54°30´-57°30´E 47°00´-49°00´N 32) 57°06´E;49°09´N 33) 61°14´E;48°36´N 34) 62°30´-65°00´E 47 30´-48 00´N 58) + 59) see loc. n°2, 3 in Kozlova 1984 loc.n°12) 60) no precise location 55°00´-57°00´E 48°30´-49°00´N	Radiolaria of boreal province The scheme of Upper Paleocene Eocene Radiolarian zones correlation is given for North Caspian Sea, River Don, River Volga middle flow, East Ural slope Western Siberia	no data	Correlation of zonal subdivision based on radiolaria, planctonic, foraminifera, nannoplankton and dinoflagellates is given

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
15 Krasheninnikov 1960	Pg Lower, Middle, Upper Eocene	Pre-Caucasus west 1) Moldavano-Psifsk 2) Zybsinsk area 3) ravine Kipyachaya 4) ravine Solenaya	1) no precise data 2) no precise data 3) no precise data 4) 42° 25´-42° 30´E 46°15´-46° 30´N	42 new species and 2 new genera are described	Shallow water association	Early Eocene foraminifera zones *Globorotalia subbotinae* Low-Middle Eocene and Mid. Eocene Rad's assemblages are discovered within foraminifera's zone *Globorotalia* *aragonensis*
16 Lipman 1950	Pg Eocene	Turkestan, central Kyzyl-Kum:1) Tamdy 2) Shchulj trough 3) Chetyr well 4) W. slope of the Tamdinsk stage W. Kyzyl-Kum 5) Dzhankoi 6) Ak-Oi 7) Usun-Kuduk, S.-W. Kyzyl-Kum	1) Tamdybulak(?) 64°36´E;41°46´N 2), 3) not found 4) Tamdytaul(?) 63°20´-63°30´E 41°15´-41°25´N 5) 34°20´E 45°40´N 6) not found 7) not found	18 new taxa described in Eocene association of Radiolaria	Shallow water association	no data
17 Lipman 1965	Cr Maestrichtian Danian Pg Paleocene Eocene	SE & W Turkmenia Turgai, Northern Pre-Aral 1) Kustanai 2) Semiozernoe 3) Saksayl'sk 4) Mis Izyndy-Aral 5) Baikonur 6) river Turgai (middle flow) 7) Aralsk 8) Kushmurun 9) Semiozernoe 10) Amangel'dy 11) Chelkar 12) Togyz 13) Mountains	1) 63°40'E 53°15´N 2) 64°06´E 52°22´N 3) 61°06´E 46°07´N 4) 59°29´E 45°48´N 5) 66°03´E 47°50´N 6+15) 60°12´E 48°49´N 7) 61°43´E 46°56´N 8) 64°37´E 52°30´N 9) 64°06´E 52°22´N	1) The distribution of 98 species is given in the Eocene deposits 2) Two zonal subdivi- sions based on Radio- laria are establi- shed a) *Spongurus* *biconstrictus* b) *Ellipsoxiphus* *chabakovi* in Tasaransk series	Alternation of deep water and shallow water Radiolarian association	*Spongurus* *biconstrictus* association occurs together with foraminifera *Nummulites* *distans* *N. murchissoni* etc. *Ellipsoxiphus* *chabakovi* association of Radiolaria occurs together

		Tas-Aran 14) Tshchebas gulf 15) Aktogai 16) Irgiz 17) Turgai	10) 65°11´E 50°12´N 11) 59°39´E:47°48´N 12) 60°32´E;47°32´N 13) 59°20´-59°40´E 46°15´-46°20´N 14) 59°40´-59°45´E 46°05´-46°10´N 16) 61°14´E 48°36´N 17) 63°25´E 49° 38´N			with foraminifera *Speroplectammina spectabilis*
18 Lipman 1976	Pg Paleocene Eocene Cr Maestri- chtian, Danian	Northern Pre-Aral Turgaisk Trough 1) Mount Tas-Aran 2) Chagrayskoye Plateau 3) Chelkar village 4) Lake Tebes 5) Tumaly-Kolj vil. 6) Turgai village 7) Saksaulskiy 8) Belgorod 9) Astrakhan 10) Krasnovodskoe pl. 11) Kustanai 12) Emba 13) Bukhara (region) 14) Chardzou (?) Komsomolsk (between Ashkhabad and Bukhara)	1) not found 2) 57°30´-58°30´E 45°45´-47°00´N 3) 59°39´E 47°48´N 4) not found 5) not found 6) 63°25´E 49°38´N 7) 61°06´E;47°06´N 8) 36°36´E;50°38´N 9) 45°30´-46°30´E 46°00´-47°00´N 10) 52°35´-52°40´E 40°10´-40°15´N 11) 62°30´E 52°25´-52°35´N 12) 54°30´-57°30´E 47°00´-49°00´N 13) 64°10´-64°30´E 39°20´-39°30´N 14) 63°34´E;39°01´N	The map with *Conocaryomma aralensis* occurrences is given	no data	no data
19 Lipman 1969	Pg Eocene	Turgaisk Trough, Northern Pre-Aral	locations are the same as in Lipman 1965	New Family-Conosphae- ridae, new subfamily Conocaryomminae, new genus *Conocaryomma* and 2 new species *C. aralensis*, *C. lentis*	no data	no data

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
20 Lipman 1972	Pg Eocene	Turgaisk Trough, Northern Pre-Aral	all location from Lipman 1965	11 new species and 11 new genus are described	Shallow water association	no data
21 Lipman 1975a	Pg Middle Eocene	Northern Pre-Aralie 1) Izyndy-Aral	1) 59°29´E 45°48´N	4 new species of Radiolaria are introduced	Shallow water association	Nummulites + Foraminifera
22 Lipman 1982	Pg Oligocene	Northern Pre-Black Sea 1) Lower Serogozsky region of Khersonsky district	1) 32°00´-32°30´E 46°25´-46°50´N	2 new species of Radiolaria are described	Shallow water association	Foraminifera + mollusc fauna
23 Lipman 1984a	Pg Paleocene Eocene Oligocene	North Western Caucasus and Apsheron peninsula		Correlation of the stratigraphical divi-sion of the Paleocene and Eocene stages based on Radiolarians and Fora minifera	Shallow water association	Foraminifera scale is provided
24 Lipman 1984b	Pg Upper Paleocene	Crimea, Bakhchisaray area 1) Bakhchisaray (v. Staroselie) 2) r. Kacha (v. Predushelnoe) 3) SuvluKaja Mount. 4) r. Belbek (near Bakhchisaray) 5) Bakhchisaray (quarry of cement's factory) 6) Kizil-Djar Mountain (v. Pochtovoe)	1) 33°53´E 44°44´N 2) 33°50´-34°10´E 44°30´-44°40´N 3) not found	Pg Radiolaria, conclusion: impossible to compare rad's asso-ciations of Crimea and Middle Asia. No Radiolaria record have been found in the sections of r. Belbek, cement quarry near Bakh-chisarai, m. Kizil-Djar (near v. Pochtovoe) and v. Staroselie	Shallow water association	Foraminifera scale is provided
25 Lipman 1993	Pg Paleocene Oligocene Eocene	North Eurasia	no precise data	Radiolarian zonation for the North Eurasia is provided and correlated with the rad's zonation sugges-ted by Sanfilippo,	no data	Correlation with foraminifera's

				Westberg & Riedel, 1981 for the Paleogene deposits of the oceans tropical realm		and nannoplankton's zonation is made
26 Lozyniak 1985	Pg Eocene, Oligocene	Ukranian Carpatians Skybe zone 1) river Cheremosh 2) r. Prut 3) r. Stryy 4) r. Dnestr	1) 25°00´-25°30´E 48°10´-48°30´N 2) 25°00´-26°00´E 48°30´-48°35´N 3) 23°30´-24°00'E 49°10´-49°30´N 4) 24°10´-24°30´E 49°20´-49°40´N	Poor to moderate preserved radiola-rian associations have been studied	no data	no data
27 Mamedov 1969a	Pg Eocene	Azerbaidjan 1) Shemakhino-Kubastanskaya area 2) Apsheronian peninsula area	1) 48°25´-48°30´E 40°30´-41°30´N 2) 49°30´-50°30´E 40°10´-40°40´N	6 new radiolarian species are described	no data	*Globorotali crassaformis, Globiger inoita* index, *Globigerina turkmenika, Globorotalia aragonensis*
28 Mamedov 1969b	Pg Eocene	Azerbaidjan 1) South-Eastern Caucasus a- Shemakhino-Ismaillinsky, b- Kubastan 2) Apsheronian peninsula	1) a- 48°37´E 40°38´N Shemakha 48°10´E;40°46´N Ismailly, b- 48°33´E;41°23´N Kubastan 2) 49°30´-50°30´E 40°10´-40°40´N	6 new radiolarian species are described	no data	no data
29 Mamedov 1969c	Pg Eocene	Azerbaidjan 1) Sumgait river	1) 48°45´-49°30´E 40°30´-40°50´N	6 new radiolarian species are described	no data	no data
30 Mamedov 1970	Pg Middle Eocene	Azerbaidjan North-East part 1) village Kirovka	1) not found	6 new radiolarian species are described from deposits of Low. Coun formation	no data	no data
31 Mamedov 1973a	Pg Up. Paleocene Low., Mid., Up. Eocene	Azerbaidjan all locations of the samples are from previous publications	1), 2) see Mamedov 1969b 3-7) no precise data	5 new radiolarian species are described	no data	*Globorotalia crassaformis*

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
32 Mamedov 1973b	Pg Eocene	Azerbaidjan 1) Shemakhinskaya area 2) Ismaillinskaya area 3) Kirovka village 4) Agdara 5) Gadshili 6) Khiljmili 7) Dijally	1), 2) see loc. n° 28 3-7) not found	5 radiolarian associative zones are established in Sumgaitskaya and Low., Mid., Up. Coun formations and correlated with 6 Foraminiferal biostratigraphical zonation	no data	8 biostratigraphical subdivisions based on foraminifera's data
33 Mamedov 1975	Pg Lower Middle Upper Eocene	Azerbaidjan	All locations are from previous publications	3 stages in the development of Eocene Radiolarians are given 1- Early Eocene, 2- Mid. Eocene, 3 - Late Eocene	no data	First stage coincides with *Globorotalia subotinae* Second stage with *Globorotalia crassaformis* Third stage with Globigerinoita index
34 Mamedova, Mamedov 1970	Pg	Azerbaidjan 1) Gadzili village 2) Shemakhinsk area	no precise data	Plates with the age, lithology and Radiolarian assemblages are provided	no data	Correlation with foraminifera data is made
35 Moksyakova 1961	Pg Upper Eocene	Western Turkmenia 1) Southern Ust-Yurt 2) Malii and Bolshoi Balkhan 3) Koimat-Dag 4) Krasnovodskoe plateau 5) Usboisk corridor 6) Erbent Tashaus (Central Karakums)	1) not found 2) 54°30′-54°50′E 39°10′-39°30′N 3) not found 4) 52°30′-53°00′E 40°10′-40°20′N 5) 55°00′-55°30′E 39°00′-39°20′N 6) 59°58′E;41°49′N	18 new species of Radiolaria are described from Kumsky horizon	Deep water association alternating with shallow water association	no data
36 Moksyakova 1965	Pg Upper Eocene	Turkmenia 1) hole 304 (Kara-Bogaz-Gol gulf) (N-W bay) 2) exp.5 [Kara-Bogaz-Gol gulf] (south part Omchali)	1) 52°55′-52°57′E 41°10′-41°15′N 2) 53°44′E 40°38′N 3) 53°45′-53°50′E 40°05′-40°10′N 4) 59°07′E	10 new radiolarian species are described from Kerestinsky and Kyberlinsky horizons	Deep water association of Radiolaria	no data

		3) hole 3 (150 km to the west from Kras-novodsk) 4) Nukus 5) Tashauz 6) Darvaza 7) Sernyy Zavod 8) Chardzhou 9) hole 35	42°28′N 5) 59°58′E 41°49′N 6) 58°24′E 40°12′N 7) 58°18′E 40°00′N 8) 63°34′E;39°09′N 9) 63°00′-63°10′E 37°30′-37°40′N			
37 Nikitina, Zagorod-nyuk 1981	Pg Eocene	1) Lower Don bassin 2) Northern Pre Caspian (rivers Sagiz- Emba) 3) Ergen-eastern Pre-Azov (western part of Karpinsky swell)	1) 40°00′-41°00′E 47°00′-48°00′N 2) Emba (see loc n° 18) 50°00′-55°00′E 47°30′-48°30′N 3) 37°30′-40°00′E 45°00′-47°30′N	Eocene Radiolaria and Foraminifera, 1) Range-charts of Eocene benthic foraminifera from South Sagiz - Eastern Part of Russky platform and Scifsky plate is given, 2) Correlation of radiolarian and foraminiferal biostrati-graphic zones is made	Plate illustrates shallow water-radiolarians and foramini feras associations	Zonation based on Foraminifera data is give
38 Radionova Khokhlova 1994	Pg Up.Paleocene formations Goryachii Klyuch, and Abaza Lower Eocene Formations: Cherkess, Zybza, Kutaisi (r. Belaya) Mid. Eocene Formations: Kaluga and Khadyzhensk (western Kuban) Oligocene Khadsum horizon of the Maikop Group	A- Crimea 1) Eupatoria 2) Nasypnoe B- Caucasus 3) Anapa C- Western Ukraina 4) Shibik river 5) Glubokii Yar 6) Balka Kipyach'ya 7) Balka Glubokaya 8) Pshish river 9) Kurdzhips river 10) Laba r. 11) Belaya r. 12) Kuban r. 13) Kheu r. 14) Urukh r. 15) Rubas-Chai r. 16) northern Kobystan (15,16) western part of Caspian Sea 17) Karagie depression 18) Bol'shoi Balkhan mountains	1) 33°20′E;45°12′N 2) near Feodosiya, no precise data 35°23′E;45°03′N 3) 37°20′E;44°54′N 4) 100-200 km S of Novor ossiysk 37°46′E;44°44′N no precise data 5) no precise data 6) no precise data 7) no precise data 8) near Goryachi Klyuch, 39°18′E;44°36′N 9) no precise data 40°44′E;44°39′N 10) near Labinsk and Shedok 40°50′E;44°13′N; 11-17) no precise data 18) 55°30′-55°20′E 39°00′-39°20′N	a) Nannoplankton and foraminifera's biostrati-graphy. b) Paleogene episodes of biogenic silica accumulation correlated with trans-gressive-regressive cycles. c) The list of Radiolarian taxa, found in Up. Paleocene-Low. and Mid. Eocene and Oligocene deposits is provided	Radiolarian as semblages are of shallow-water origin except Mid.Eocene association discovered in Dagestan (Rubas-Chai r.)	Nanno-plancton foraminifera silicoflagellates, diatom

Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other fossils
39 Runeva 1969	Neogene Miocene	Pre Carpatian 1) Kalush-Zoljnyi zone 2) Vyrva r. 3) Banevichi v. 4) Tarnavka r.	1) 24°20´E;49°02´N (Kalush) 2) no precise data 3) no precise data 4) no precise data	Lower Miocene generic composition of the radiolarian association from Verbovetsk layers of Vorotyshchensky series is provided	no data	no data
40 Subbotina 1960	Paleogene Neogene Oligocene Lower Miocene Zagorsky series	Pre Carpatians, East Carpatians 1) Vorotyshche r. Polianitsky, Vorotyshchensky, 2) Slonitsa r. 3) Tysmenitsa r.	1) 23°31´E;49°16´N 2) no precise data 3) no precise data (near city Truskavets)	6 radiolarian taxa were found. Preservation is very poor. Redeposition	no data	Oligocene *Globo rotalia denseconnexa subbotinae*, *Globigerina pseudoedita* Miocene redeposition of Foraminifera has been observed.
41 Tochilina 1969	Pg Upper Paleocene, Lower Middle Upper Eocene	Voronesh anticline 1) Russkaya Zhuravka v. 2) Eryshevka v. 3) Semenovka v. 4) Gavrilinsk 5) Pavlovsk	1) 40°35´;50°21´N 2) no precise data 3) no precise data 4) no precise data 5) 40°07´E;50°28´N	Early, Middle, Late Eocene radiolarian associations are given, no Radiolaria in Oligocene sediments	no data	no data
42 Tochilina 1975	Pg Upper Paleocene Lower Eocene Middle Eocene Upper Eocene	Voronesh anticline 1) territory within square: Rossosh v.-Losevo v.-Kalach-Boguchar v. 2) near Chuguev v. 3) near Belgorod v. 4) near Obojan v. 5) near Kantemirovka v. 6) near Veshenskaya v.	1) Rossosh-39°35´E 50°12´N Losevo- 40°02´E 50°41´N Kalach- 41°02´E 50°26´N Boguchar- 40°34´E 49°58´N 2) 36°44´E;49°51´N 3) Belgorod 4) no precise data 36°36´E;50°38´N 5) 39°52´E 49°40´N 6) 41°45'E;49°39´N	Up. Paleocene (Sumskaya form.) Low. Eocene (Kanevskaya f.) M. Eocene (Kievskaya form.), Up. Eocene (Kharkovskaya formation) Three periods of radiolarian fauna development are established I- Late Paleocene-Early Eocene II- Late Eocene-Kievsky III- Late Eocene-Kharkovsky	Alternation of shallow and deep water radiolarian associations	Up. Paleocene alternation of radiolaria & Molluscs bearing deposits Low. Eocene Radiolarians with Foraminifera Mid. Eocene Radiolarians. with Foraminifera & Molluscs Up. Eocene alternations of Molluscs & and Rad.' bearing deposits

43 Zagorodnyuk 1969	Pg Upper Eocene	Russian platform 1) Lower flow of the Don river Pre-Caspian lowland 2) the bassin of the Northern Emba Azovo-Kubansk through and 3) Azov elevation a- Sal'sk b- Alexandrovskoe c- Kanevskaya d- Rostovskaya 4) Salo-Manych inter-fluve a- r. Manych b- western Ergen (Ulan Erge)	1) 40°00´-41°00´E 47°30´-47°45´N 2) see loc n°14 3) a- Sal'sk- 41°33´E;46°30´N b- Alexandrovskoe (Stavropol)- 42°59´E;44°45´N c- 38°57´E;46°05´N d- 39°45´E;47°15´N 4) (North Pre-Caspian) a- 40°10´-40°40´E 47°10´-47°00´N b- 44°52´E;46°17´N	3 different Radiolarian associations for the Lower Don river flow and 4 assemblages for Northern Emba (Pre-Caspian) have been described Kuberlinsk, Ke-restinsk, Kumsk and Beloglinsk layers from Emba and (Northern Pre-Aral) Tasaranskaya, Saksaylskaya, Cheganskaya	Deep-water and shallow water Radiolarian association	no data
44 Zagorodnyuk 1975a	Pg Eocene	Russian platform Lower flow of the Don river	no precise data	Peculiarities of the morphological struc-ture of some Sphaer-oidea and Discoidea	no data	no data
45 Zagorodnyuk 1981	Pg Mid.,Up. Eocene boundary	1) South-Eastern part part of Russian platform 2) Eastern Pre-Caspian	no precise data	The taxonomical compo-sition of radiolarian assemblages from Bakhchisaraisky and Simferopolsky layer is described	Shallow water radiolarian associa-tions	correlation with biostratigraphical zonation based on foraminifers data is provided

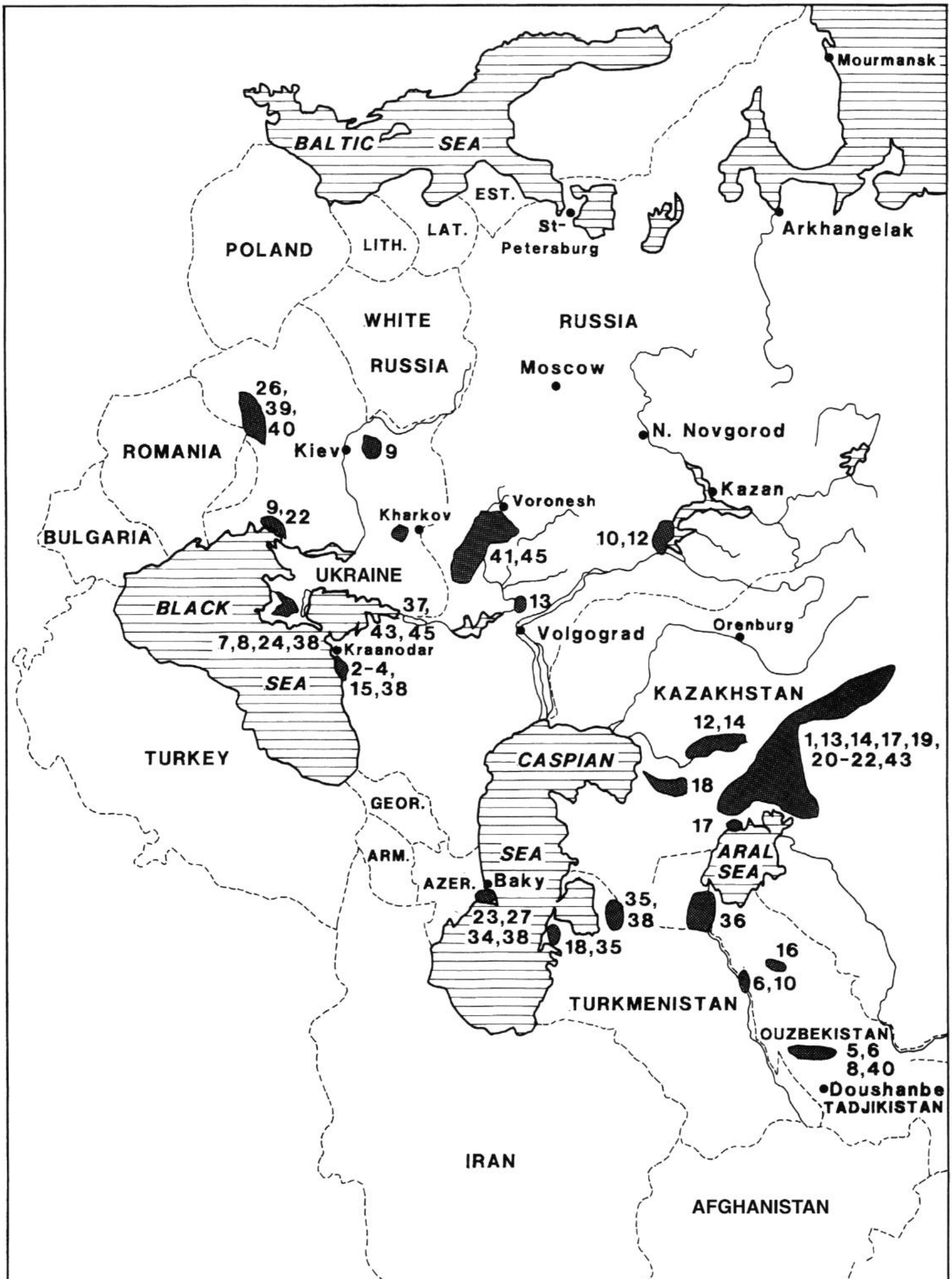

FIG. 6. — General map of eastern Peri-Tethys domain showing the investigated regions listed on Table 2. Main areas of investigation are marked with grey zones. The numbers refer to those given on Table 2. Detail maps are provided from west to east on Figs 7-22.

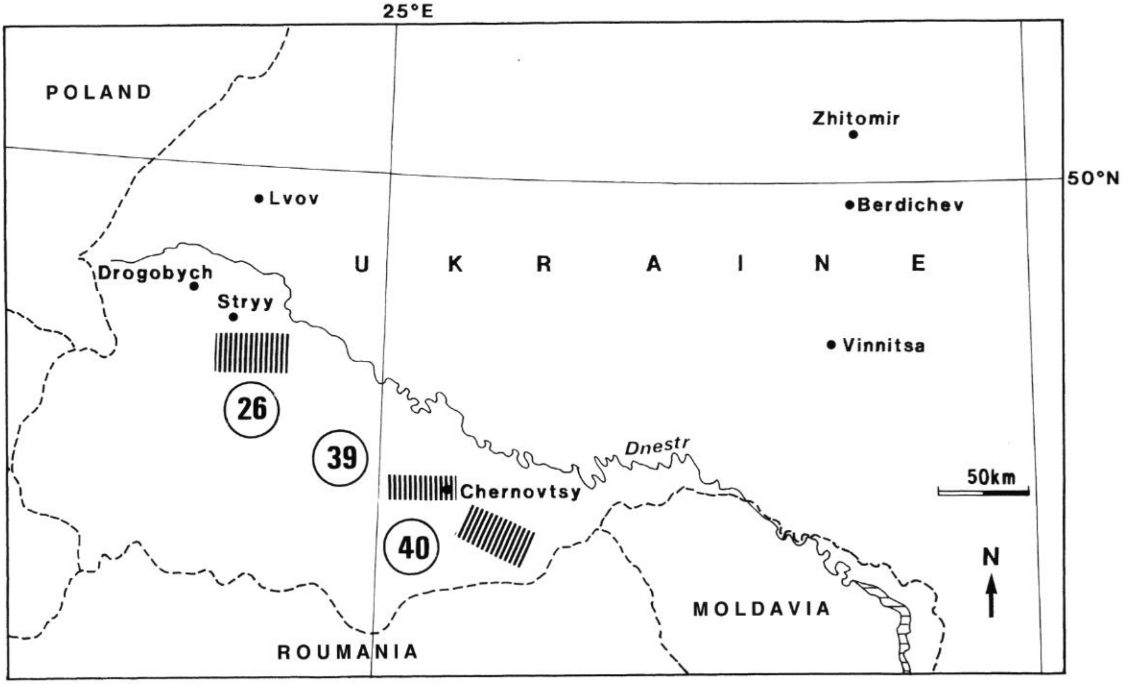

FIG. 7. — Location map of sites used in previously published investigations of Ukraine, south of Lvov (25°E, 50°N).

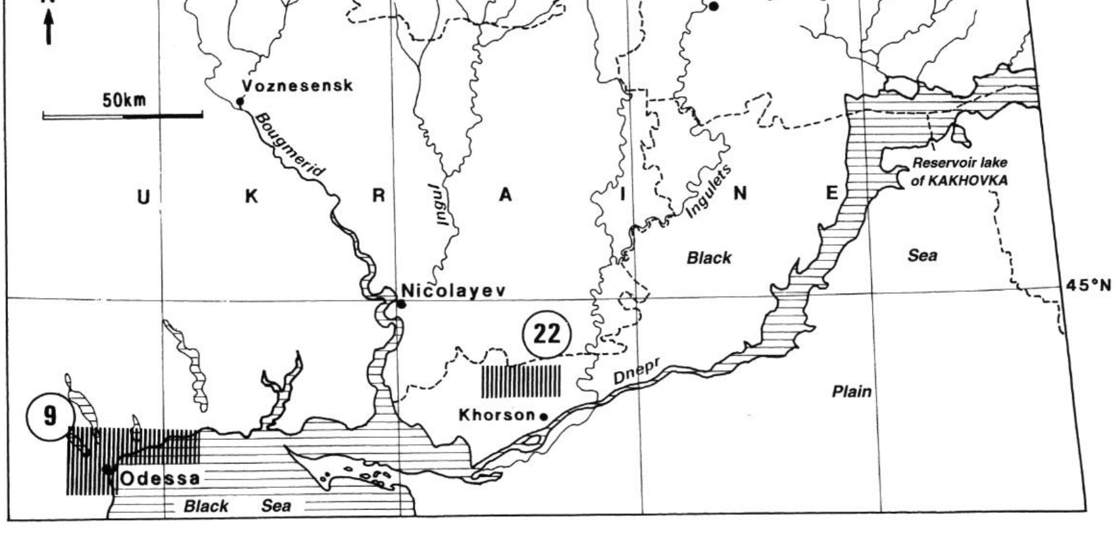

FIG. 8. — Location map of sites used in previously published investigations of Ukraine, northern Black Sea region, near Odessa (31°-34°E, 45°N) .

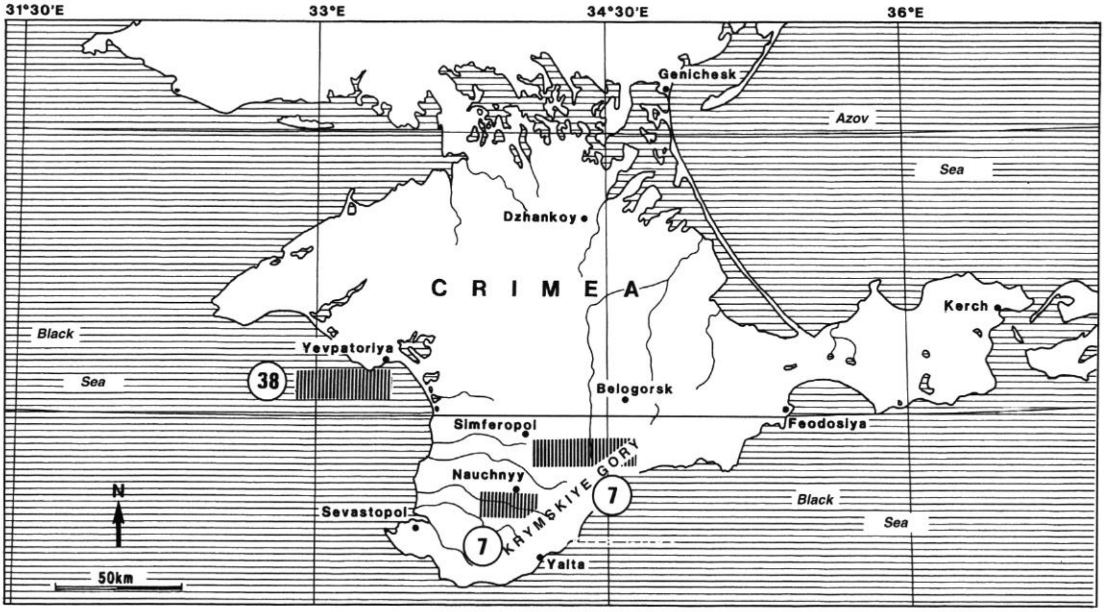

FIG. 9. — Location map of sites used in previously published investigations of the northern Black Sea region Crimea (31°-36°E).

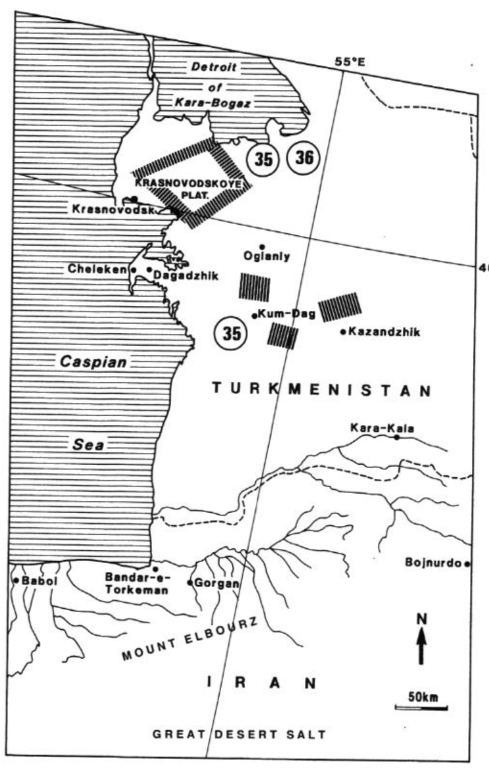

FIG. 10. — Location map of sites used in previously published investigations of the east Caspian Sea, Krasnovodsk area (55°E).

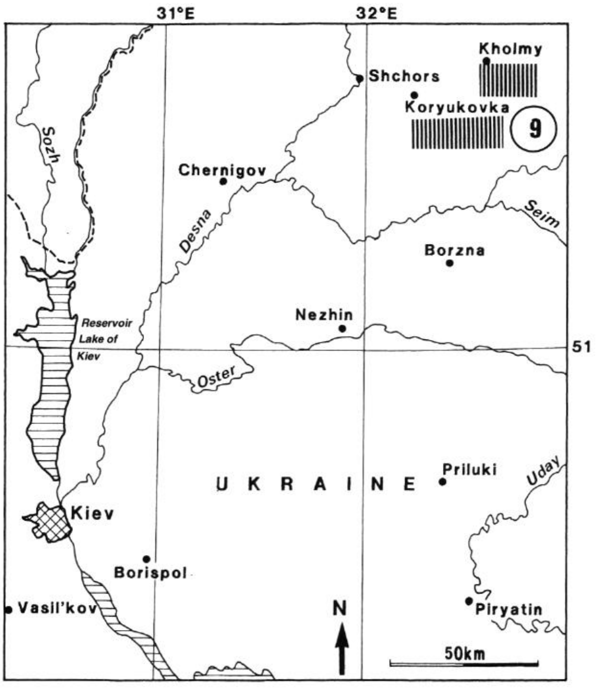

FIG. 11. — Location map of sites used in previously published investigations of Ukraine (31°-32°E, 51°N) in the NE Kiev area.

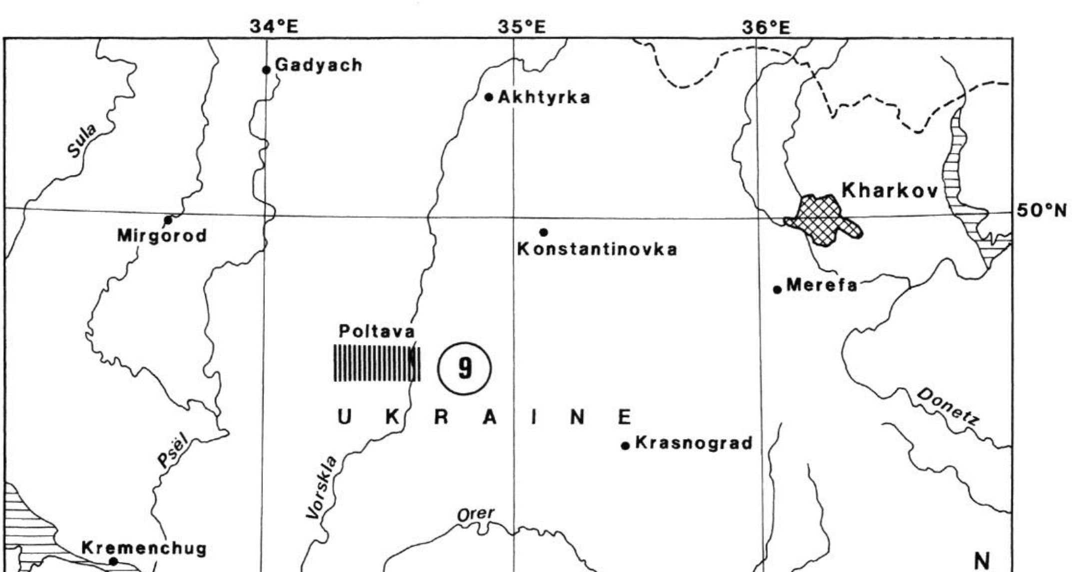

FIG. 12. — Location map of sites used in previously published investigations of the northern Black Sea region in the Kharkov area (33°-37°E, 50°N).

FIG. 13. — Location map of sites used in previously published investigations of the northern Black Sea region in the Lougansk-Stakhanov area (37°-39°E, 48°-49°N).

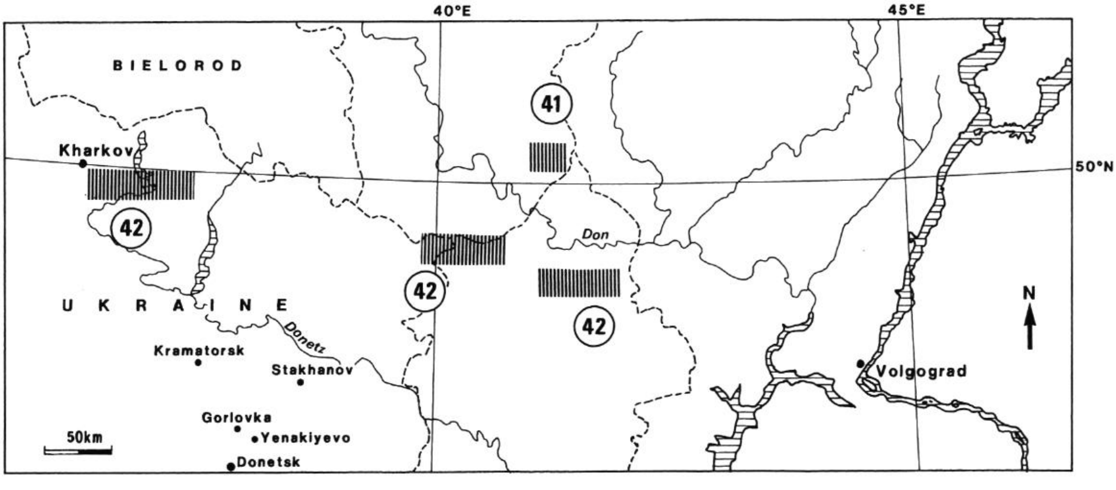

FIG. 14. — Location map of sites used in previously published investigations of eastern Ukraina and south-western Russian platform, Kharkov-Volgograd area (40°-45°E, 50°N).

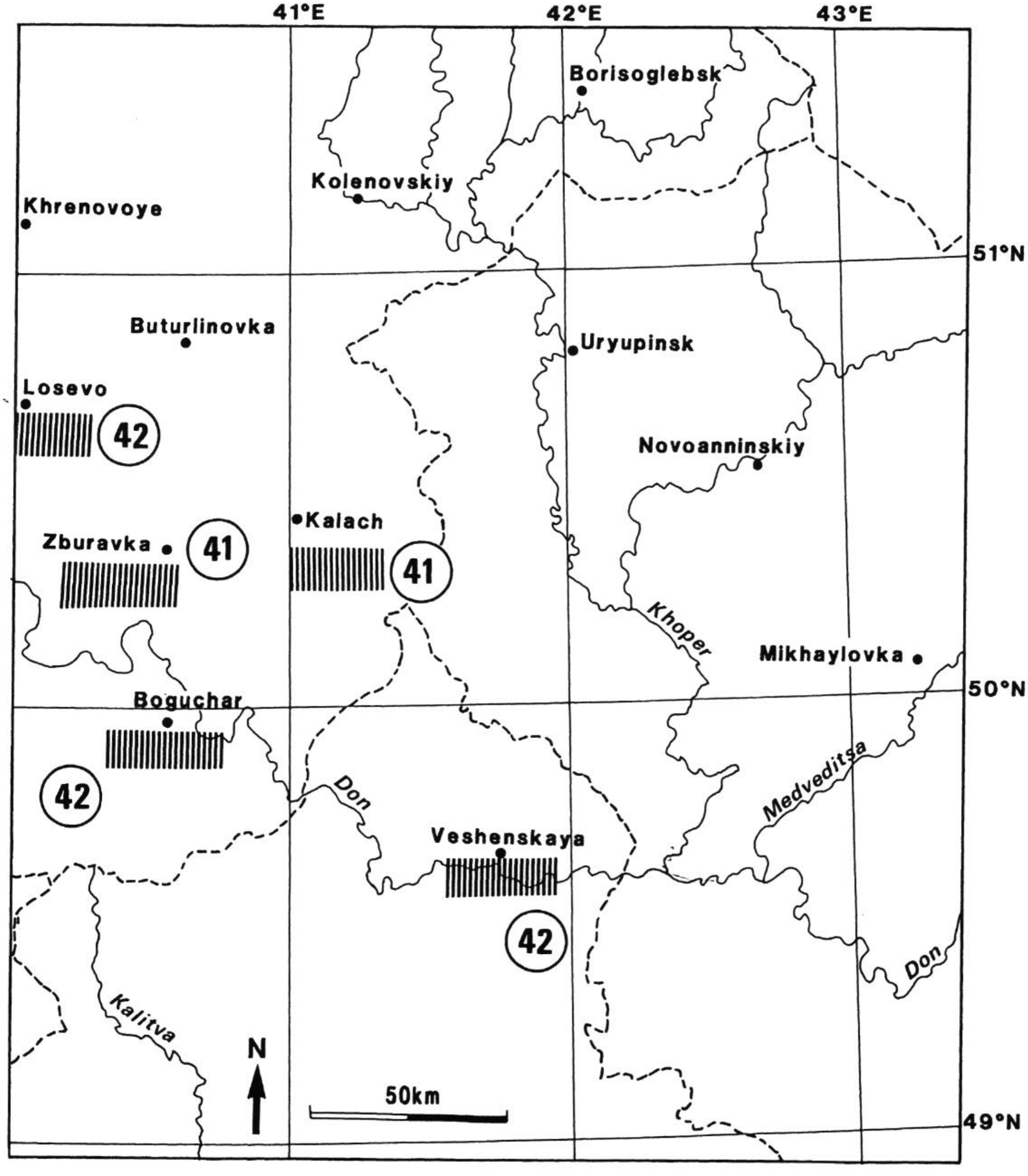

FIG. 15. — Location map of sites used in previously published investigations of eastern Ukraine and south-western Russian platform, Voronesh area (40°-43°E, 49°-51°N).

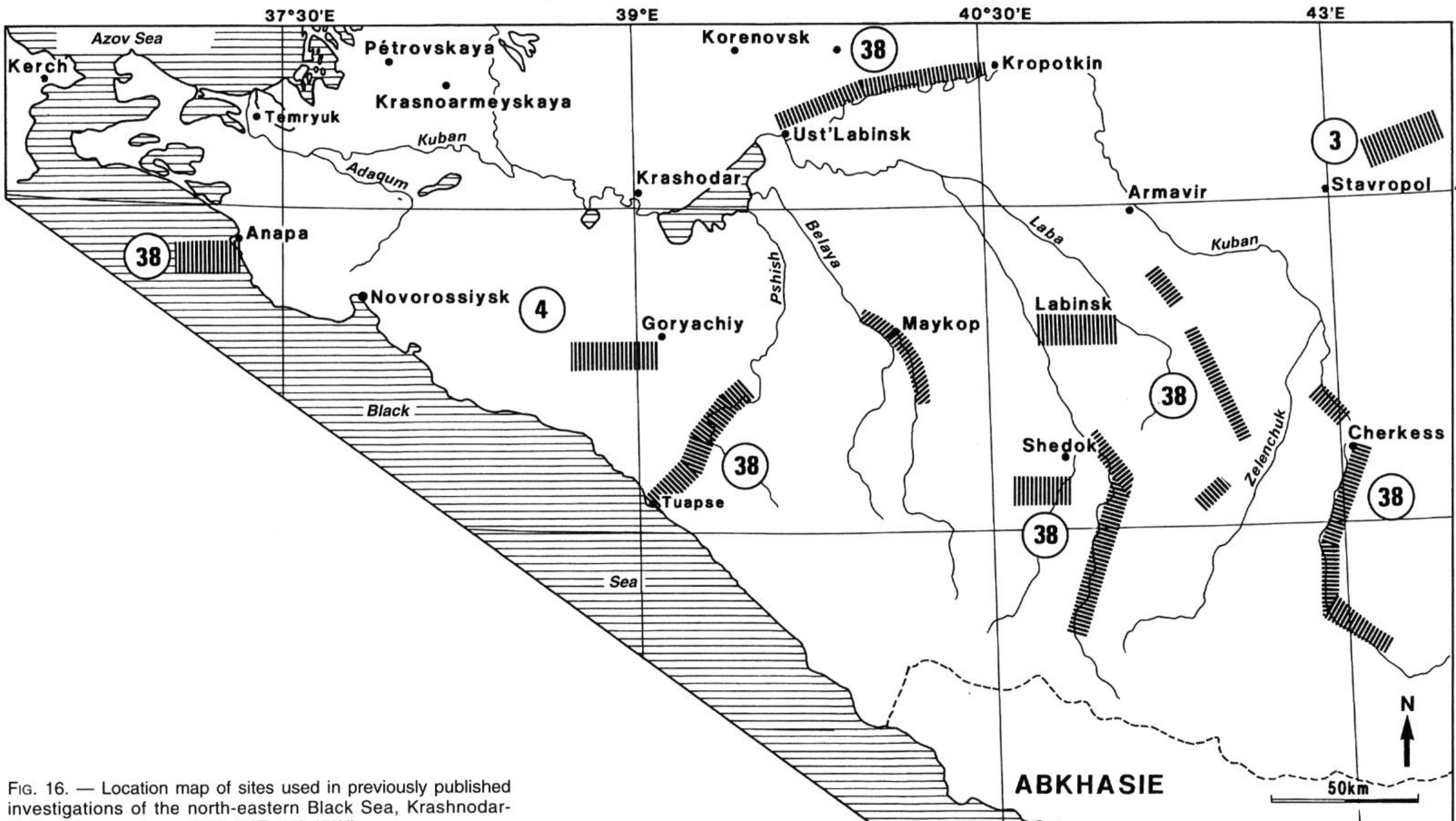

FIG. 16. — Location map of sites used in previously published investigations of the north-eastern Black Sea, Krashnodar-Maïkop-Stavropol area (37°-43°E, 44°-45°N).

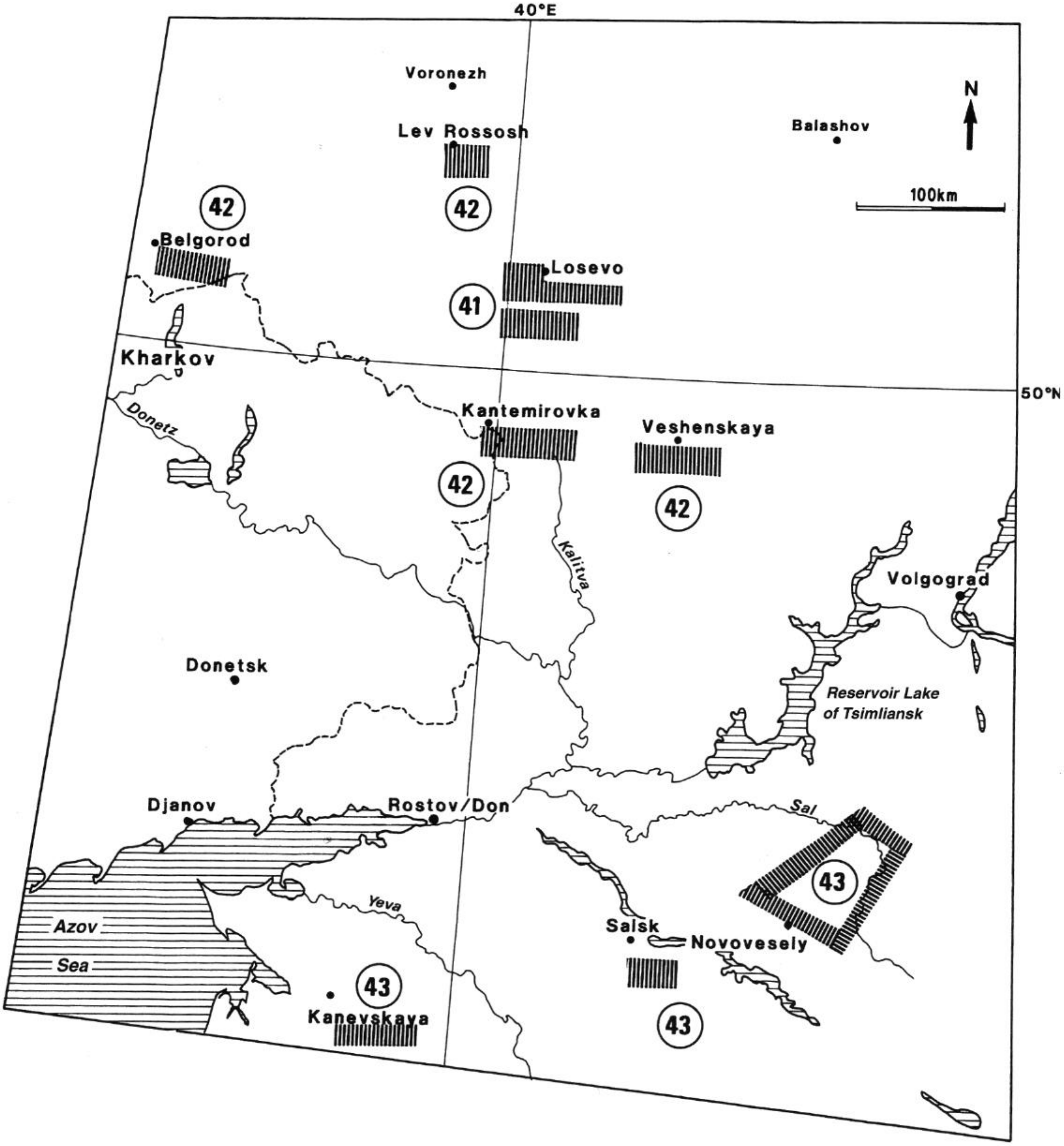

FIG. 17. — Location map of sites used in previously published investigations of the eastern Black Sea, and eastern Ukraina-southwestern Russia: Kharkov, Rostov-on-Don and Volgograd regions (40°-45°E, 50°N).

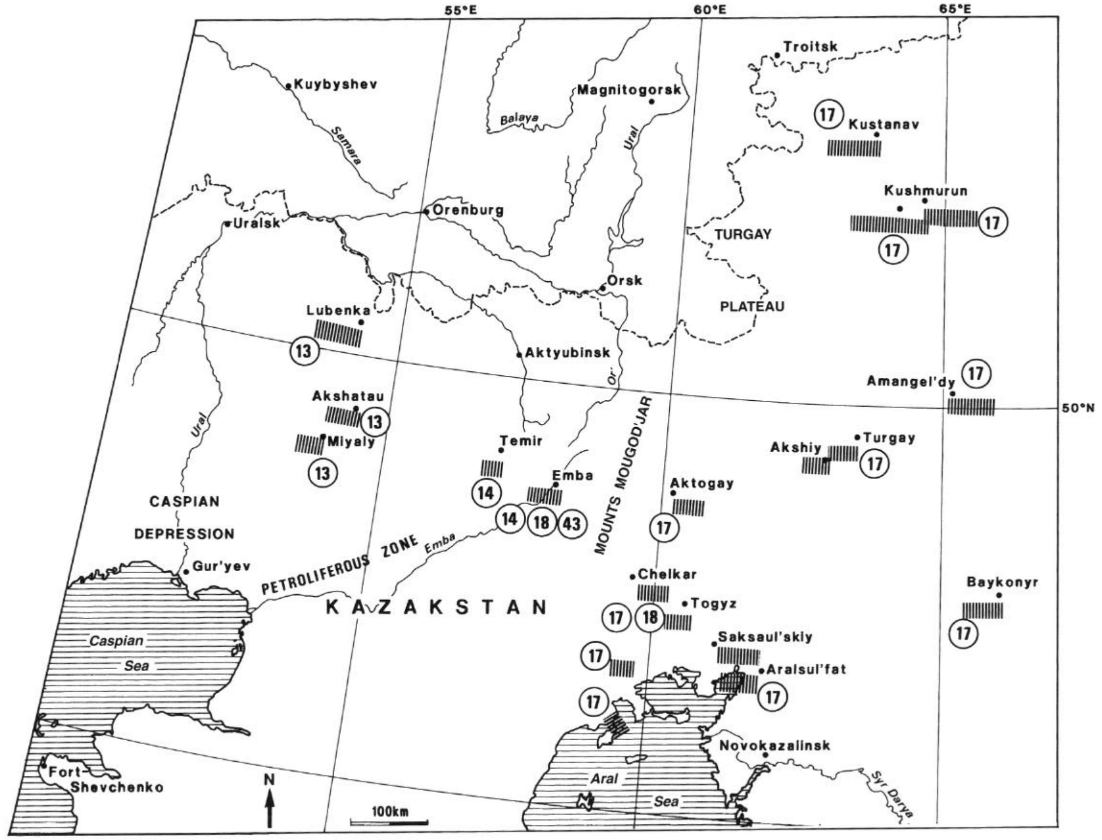

FIG. 18. — Location map of investigations published on northern Kazakhstan-north of Caspian Sea: Kuybishev, Orenbourg and Baïkonur areas.

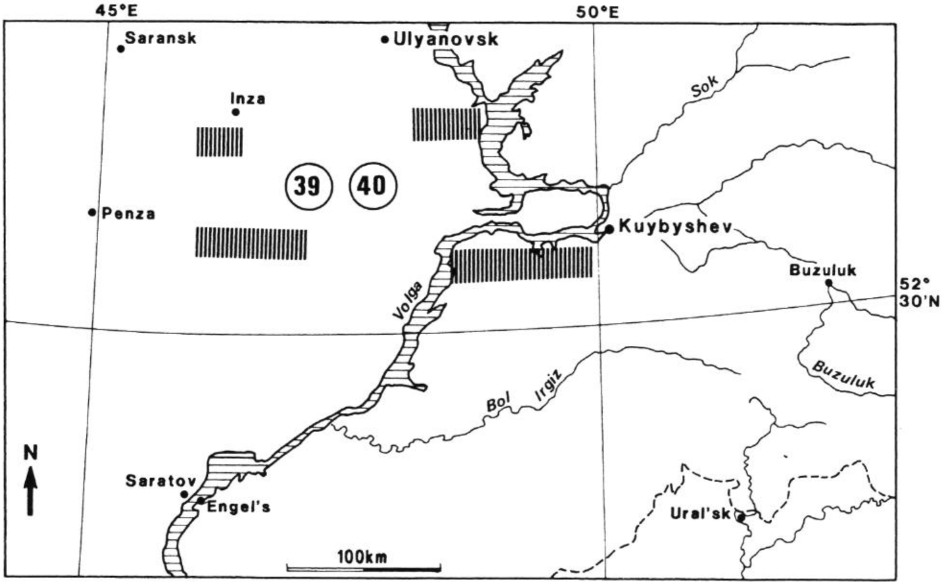

FIG. 19. — Location map of sites used in previously published investigations of the middle Volga between Saratov and Kuybishev (40°-50°E, 52°N).

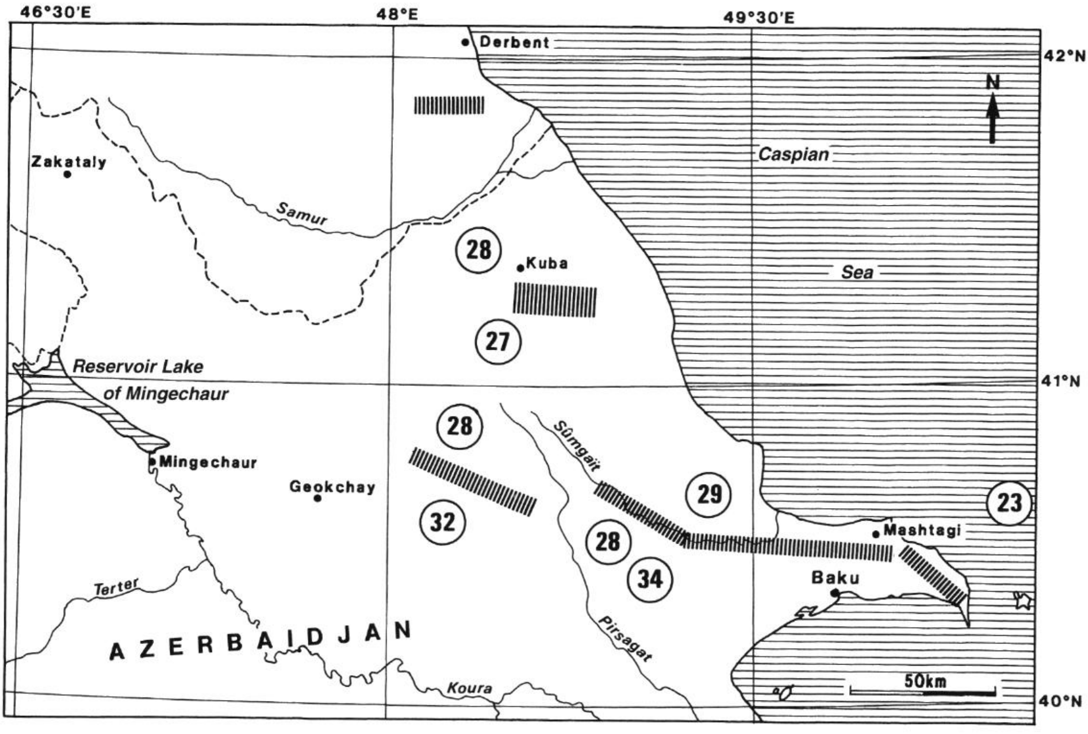

FIG. 20. — Location map of sites used in previously published investigations of Azerbaidzan, Baku area (46°-50°E, 40°-42°N).

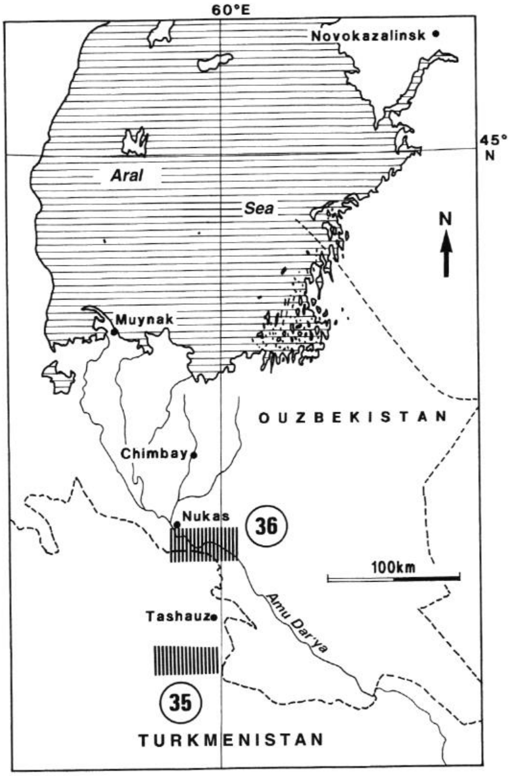

FIG. 21. — Location map of sites used in previously published investigations of the south Aral Sea (NW Ouzbekistan, Nukus area, 60°E, 42°N).

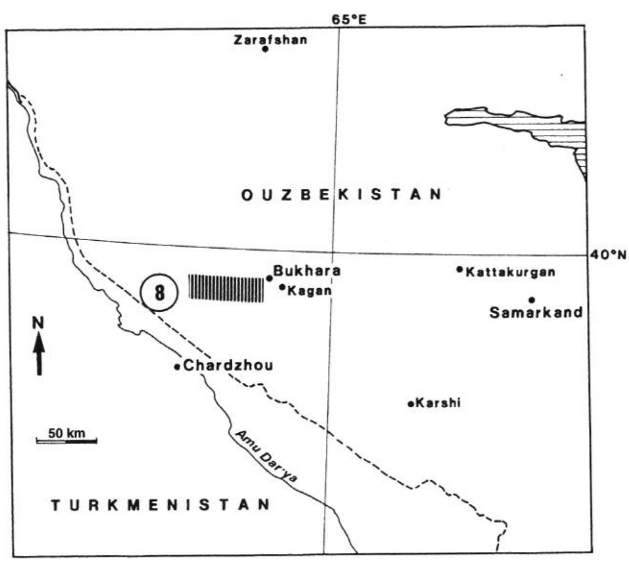

FIG. 22. — Location map of sites used in previously published investigations of on south-east Aral Sea (central Ouzbekistan, west Samarkand area, 65°E).

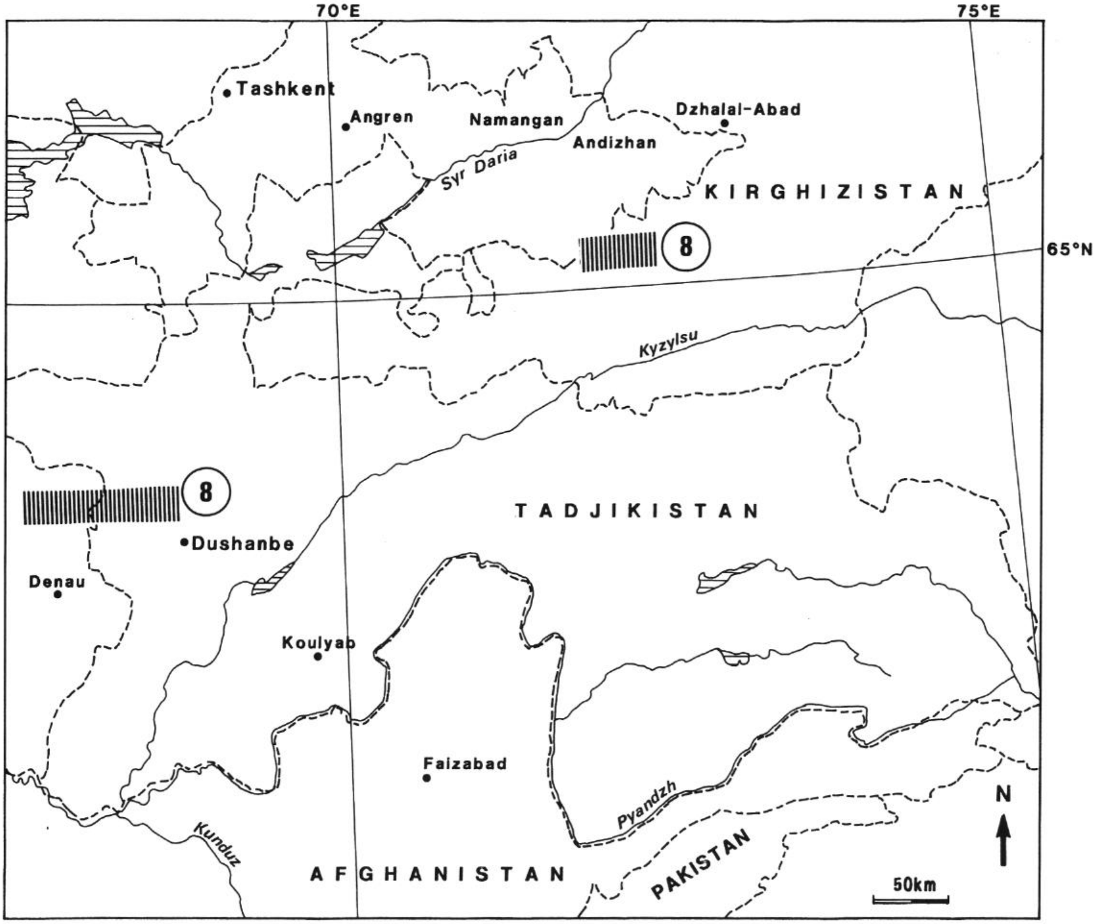

FIG. 23. — Location map of sites used in previously published investigations of Tadjikistan and Dushanbe area (70°-75°E, 65°N) .