Mesozoic radiolarians from the European Platform: a review

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ABSTRACT
This paper is primarily concerned with providing an overview of studies on Mesozoic radiolarians and presents a general background of living radiolarians and the different stages they go through (the filters) from their state as plankton to their state as fossils, as geologists find them in rocks. This is followed by a review of the main publications documenting radiolarians worldwide since their discovery. The main purpose of this paper is to present to westerners the various work related to the eastern European platform countries (European part of the former Soviet Union) as the majority of these papers are written in languages unfamiliar to most geologists. We have therefore chosen to present here their historical background, and their location, as precisely as possible, in order to allow further comparisons.

KEY WORDS
radiolarians,
Peritethys,
Mesozoic,
Silica,
plankton.

RÉSUMÉ
Nous présentons ici un survol des études ayant porté sur les radiolaires mésozoiques. Nous nous intéressons d'abord au contexte général des radiolaires en tant qu'organismes vivants et aux étapes qu'ils franchissent (les filtres) depuis leur état d'organisme planctonique jusqu'à leur état de fossiles, tels que le géologue les rencontre dans les roches. On envisage ensuite les principaux travaux à travers le monde permettant de mieux les connaître, depuis leur découverte. Le principal but de cet article est de mettre à la disposition de la communauté occidentale les résultats portant sur la partie orientale de la plate-forme européenne (partie européenne de l'ex-Union Soviétique), ces travaux étant le plus souvent difficile d'accès à la plupart des géologues. Nous avons donc choisi de présenter ici leur contexte historique, et leur localisation, aussi précisément que possible, afin de permettre leur utilisation et des comparaisons ultérieures.

MOTS CLÉS
radiolaires,
Péritéthys,
Mésozoïque,
Silice,
plancton.

INTRODUCTION

Stratigraphical correlation has been hampered by lack of world-wide cooperative studies. Now that scientific exchange is easier between Eastern and Western workers the solutions to many stratigraphic problems may be found through joint projects and enable researchers to compile a more complete fossil record. Improved networking can now allow interested workers to develop models that will facilitate more accurate interpretations of geological basins. The goal is to make biostratigraphical basin analyses a more useful tool both for industry and for academics. Some fossil groups have been studied for a long time, are relatively well known and their correlations between several basins are possible, even though still imperfect. On the contrary, other fossil groups remain almost ignored with potentially important groups often overlooked as stratigraphic tools. The utility of these groups is excellent when systematic conformity is applied by the specialist communities. The changing relationship of some fossils groups with other groups often signals changes in basin and oceanographic conditions. Taxonomic and stratigraphic syntheses are published or in preparation from Tethyan regions but often no correlation is possible with geographical areas which were under Boreal influence. This gap in our knowledge results from: (1) different palaeogeographic domains (Boreal *vs* Tethyan); (2) the fact that much of the Boreal data was acquired in eastern countries where methods and technical means are different (*i.e.* no common use of the scanning electron microscope). Comparisons between the relevant fossil assemblages are problematical partly because of the inaccessibility of much of the published literature, especially in reference to the taxonomy, and partly because of the lack of good photographic illustrations in the published monographs.

In order to progress towards the correlation between Boreal and Tethyan basins it is first necessary to standardise the different biological chronometers of the existing studies available. The objective is to consolidate information so that other geologists interested in these deposits can use the interrelationship of microfossils as a valuable tool. Other indirect benefits are to be able to understand Russian terminology in translation, and eventually, standardise terms. Our project will be accomplished by developing a three-fold process, each part of which can be carried out simultaneously. Firstly a state of the knowledge has to be settled: this is the objective of the present paper. Secondly the systematics must be dealt with (re-examination of the taxonomy of some selected fossil groups from western basins and from the Russian Platform, Caspian Sea Region, Siberian Lowlands, North Kazakhstan, ... which have been worked on by many specialists). Thirdly, to develop biostratigraphical and palaeoenvironmental application by comparisons of lithology, geologic history, abundance and diversity with other fossils. This enormous task will then allow problems to be jointly stated and solutions to be recorded.

To extrapolate the original biological environmental signals from the geological features recorded requires a good knowledge of (i) successive filters which have changed it and of (ii) the originators of these signals (*i.e.* the radiolarians). Radiolarians have existed since the Cambrian (Nazarov & Ormiston 1993) and comprise several thousand species. They were disregarded for stratigraphic purposes for a long time, but since Riedel (1952, 1957) proved their stratigraphical worth, they have been studied more thoroughly, especially since the 1980's and their high value is now established. Because of the difficulty extracting radiolarians from siliceous rocks, the first zonations were only proposed for the Cenozoic and the Mesozoic during late 1970's (beginning with the Cretaceous then the Jurassic and later for Triassic times) and for the Palaeozoic since the 1980's.

INTERPRETATION OF OBSERVATIONS

The initial stratigraphic problems were due to the initial taxonomy which used an unnatural taxonomic system and which did not reflect phyletic relationships. This phase in the progress of Cenozoic radiolarian taxonomy and stratigraphy has depended largely on material collected. As more natural groupings replace the artificial ones of Ehrenberg and Haeckel, genera and families that extend from Palaeozoic to Mesozoic, or from Mesozoic to Cenozoic, become the peculiarity rather than the rule (Riedel 1967b). The Haeckelian system of radiolarian classification now persists in use only to the extent that the arduous task of the tracing of phyletic relationships remains incomplete. Disputable taxonomy for some radiolarians hampers the registering of assemblages in their entirety, at the level of species. many taxa are variously delimited by different authors, so that a work has little utility unless it describes and illustrates (or refers to a published, illustrated description of) the morphological variability involved for each name. A perplexing decision to be required, at the beginning of an investigation of radiolarian stratigraphy, is the extent to which it is appropriate to quantify abundances of taxa. It is generally unsatisfactory to record only presences and absences, because the observation of hundreds of specimens of a taxon in an assemblage clearly carries more weight in interpretations than does a single specimen. And an absence recorded after searching through few specimens has less meaning than one recorded after searching through ten thousand. On the other hand, it can be a futile effort to count abundances with great precision, unless detailed palaeoenvironmental interpretations are the main goal. When thousands of specimens are present on each slide, as it is commonly the case in Cenozoic radiolarian studies, it is possible to conduct a middle policy between excessive and insufficient quantification by estimating how many specimens must be searched through, to find a certain number of specimens of the taxon being recorded, and then converting this number to a ratio of the total assemblage. The resulting estimates of abundance are useful not only for the weighting of biostratigraphic events but also for broad-scale palaeoenvironmental indications. Preservation of the radiolarians is another important factor in stratigraphic interpretations, for the recording of which there are not, as yet, any satisfactory conventions. It is not unusual for authors to record assemblages as "well *vs* poorly preserved", "slightly *vs* greatly corroded", etc., and these indications are useful in evaluating the significance of absences of delicate species from the assemblages, or concentrations of particularly robust species.

From plankton to rock

Radiolarians, present in all oceans and open seas, are floating predators and include in their cytoplasm symbiotic algae (zooxanthellae) which also contribute to their nutrition. Several groups of radiolarians have a high endoplasmic content of oil-droplets. A connection with volcanism, which has always been presumed, is erroneous. Radiolarians live in the upper part of the water column and do not require a deep ocean. A latitudinal distribution does exist for radiolarian associations. It is also possible to differentiate surface from subsurface assemblages. In sediments below upwelling sites a mixture of fauna systematically occurs: cold and warm-water species as off Peru where Antarctic waters are mixed with tropical waters (De Wever *et al.* 1995, NAUTIPERC), surface and subsurface waters as off Somalia (Caulet *et al.* 1992). Hence, the chances of distinguishing Tropical-Tethyan as against Boreal fauna when working on fossil radiolarians extracted from radiolarite are almost non-existent since radiolarite facies result from upwelling systems (De Wever *et al.* 1994, elf). It is therefore necessary to investigate radiolarians from other facies to be able to depict bioprovinces and the sediments of the Russian platform, having both Tethyan and Boreal influences, are good candidates. Polycystines (a Superorder), with their siliceous skeleton, are the only radiolarians *s.l.* which are preserved as fossils. At present, among Polycystines, the order of Nassellarians are the most diversified, although those of the order of Spumellarians seem to be the most abundant (Lombari & Bowden 1982).

After death, an individual test is at least partially dissolved during its settling through the water column, then while it lies on the sea floor and finally within the sediment. Most of the radiolarians that settle occur in faecal pellets. Sediments deposited at the same time as the biota tend to average out the background variations such as seasonal changes. Robust forms and those of blooms are over-represented in sediments when compared with the common plankton (Swanberg & Bjørklund 1992). The numbers of individuals and species are lower in sediment (and *a fortiori* in the rock) than in plankton. It is estimated that less than 1% of the silica fixed by planktonic organisms in surface waters is preserved within the geological record. This difference is greater when planktonic individuals are not abundant. Radiolarians may be abundant in relatively shallow basins close to a shoreline where prevailing chemical conditions favour their preservation and where detrital input is very low, *e.g.* the Santa Barbara Basin, off California at a depth of below 500 m (Kling 1979). Other examples can be quoted in Norwegian fjords (Swanberg & Bjørklund 1992). Abundant radiolarians and foraminifers frequently share the same geographical water domains but in sediments they are often mutually exclusive: when siliceous fossils are preserved, calcareous ones are not and *vice versa*. Radiolarians behave as other planktonic organisms: the most important factor being the abundance of nutriments, not the abundance of silica. A scenario where transgressions are associated with a significant input of organic matter and a radiolarian bloom has been proposed by Steinberg (1981) for the main epochs of silica deposition.

The biogenic silica Opal-A is unstable and transformed into Opal-CT then into quartz. Transformations from opal to quartz are separated by a liquid stage (Carr & Fyfe 1958; Mizutani 1966). Temperature and time strongly affect silica diagenetic phases (Murata & Larson 1975). Hence, chert prevails in older or deeper sediments and porcelanites in younger or shallower ones. 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 only one dimension (the thickness) and the important decompacting factor has to be taken into account when accumulation rate and palaeoproductivity calculations are made (De Wever *et al.* 1994). In addition to pressure and temperature, time favours both opal transformations. Cherts thus are more prevalent in older sediments (Palaeozoic and Mesozoic) and porcelanites in more recent ones (Cenozoic). The transformation of Opal-A to Opal-CT is estimated to occur at 25-50° and takes 20 m.y. in areas of low to moderate sedimentation rates and 5-10 m.y. in areas of high sedimentation rates (Kastner 1981). The Opal-CT to quartz transformation occurs within 40-50 Ma (Keene 1976). All the possible modifications which affect a radiolarian test (dissolution in the water column, near the sediment-interface and during diagenesis) after its death are so great that the chances for a skeleton to be observable by a geologist are almost zero, especially when one adds the etching with hydrofluoric acid to free the test from the rock in the laboratory.

Potential importance of radiolarian contribution to marine petroleum source rocks

As shown by Lisitzin (1971), those areas in modern oceans that have high organic productivity are invariably rich in diatoms and/or radiolarians, and these are deposited in the bottom sediment. Primary production of organic matter in the present-day marine environments is mainly assumed by various group of unicellular, microscopic planktonic organisms. Radiolarians were probably an important producer during Palaeozoic and early Mesozoic times when planktonic foraminifers, coccoliths and diatoms had not emerged (Ormiston 1993). Production of biogenic silica and marine organic matter both result from a high planktonic activity (Takahashi 1986; Diester-Haass *et al.* 1992; Caulet *et al.* 1992; Sarnthein *et al.* 1992) but do not always remain associated in sediment (De Wever & Baudin 1996).
Some source rocks have their kerogen present as structureless, amorphous material not attributable to any specific organism. It is not uncommon, however, to read references to such structureless amorphous material as being of "algal" origin despite a lack of rigorous proof. It is suggested by Ormiston (1993) that radiolarians, which are a common biotic element in source rocks, could have contributed significantly to their organic richness as they are known to

contain significant concentrations of lipids, even though the identity of those lipids remains a mystery. A steady contribution of radiolarian lipids to ocean sediments could have been mediated by the minute faecal pellets (minipellets 10 to 30 μm in size) these organisms have recently been found to produce (Gowing & Silver 1985). The main biochemical components of radiolarians consist of carbohydrates, protein and lipids, the latter being an important component of organic molecules accreted in the sediment. Certain colonial radiolarians are particularly lipid-rich (Anderson 1983). The organic carbon content of such colonial radiolarians is, naturally, high. If this lipid-rich material accretes in substantial amounts in oceanic sediment, it ought to be a significant contributor to organic richness of those sediments. Some modern colonial species which are lipid-rich (see illustrations *in* De Wever 1994) and have a preservable skeleton are abundant at certain times of the year in oceanic waters. Calculation reveals a significant potential contribution of lipid input to modern ocean sediments by colonial radiolarians. We can reasonably infer that ancient radiolaria also contained substantial lipid-rich vacuoles as these are so important, both as a food resource and as an aid to flotation. Radiolarians are predators and feed from a diverse range of food sources (Swanberg & Anderson 1985) which suggests that they would have access to such a selection of molecules that their biochemical make up might be highly varied. Moreover, their symbionts contribute to an important extent to the lipid droplets included in their central capsula, either directly or indirectly (Anderson 1983). The directness of the pathway from these symbiotic algal cells to the lipid droplet of radiolarians suggests that those lipid droplets in radiolarians might have molecules with an "algal signature". Research is still needed to recognise possible biomarkers in living radiolarians. The identification of a diagnostic radiolarian would not only provide a means to identify radiolarian contribution to lipid-richness of ancient sediment. At least until such chemical evidence is available one should include palaeontological study of body fossils in any study attempting palaeoenvironmental characterisation of such sedimentary rocks because of several factors: (1) silica may act as a dilutent of the organic matter (Bogdanov *et al.* 1980; Aplin *et al.* 1992); (2) porosity has an important role in the preservation or otherwise of the organic matter, permitting exchanges, oxygenation or action of sulphates which destroyed it (Aplin *et al.* 1992). To conclude, there is a relation between organic matter and silica but there is more than one parameter that influences their abundance in sedimentary rocks and these factor's identity and importance are not well identified yet. They both result from a high productivity but, as their conditions of preservation are not the same, they are not systematically associated in sedimentary rocks. It would now be of great interest to compare these Mesozoic depositional sites with some other related facies such as phtanites of Western Europe.

HISTORICAL BACKGROUND

In order to present a general scope of the studies, we have chosen to address the general state of world-wide knowledge, with special emphasis on Europe, before providing all the information from Russian platform in a more detailed form.

Although Ehrenberg (1854-1856) had sufficient marine sediments and land-based samples to provide a general portrait of Cenozoic radiolarians, he did not possess good Mesozoic samples. Consequently it was Zittel (1876) who described the first few Cretaceous radiolarians from northern Germany. At about the time that Haeckel (1881, 1887) was publishing his taxonomic system of radiolarians collected by the *Challenger* Expedition, Rüst (1885, 1898) was working on a broadly based investigation of European Mesozoic and Palaeozoic assemblages. Rüst applied Haeckel's generic names, initiated for Cenozoic radiolarians, to his pre-Cenozoic forms. An unfortunate consequence is that many of the genera introduced by Haeckel in 1881 have, as type species, Mesozoic forms described by Rüst (1885) from poorly preserved assemblages, because Haeckel's descriptions of species did not materialize until 1887. Accordingly many of Haeckel's genera are not as firmly based as they would have been with well-preserved Cenozoic forms as their type species, and a tendency was initiated for Cenozoic and Mesozoic forms to be assigned to the same genus, encouraging an impression that radiolarian genera have long stratigraphic ranges. During the following decades, Cretaceous radiolarians were described from many scattered localities (Table 2), but there was little stratigraphic progress because of the unnatural taxonomic system used. In an effort to overcome this obstacle, Hinde (1897, 1900) began to expand the remark by Rüst (1892) that Mesozoic radiolarian assemblages include higher ratio of cyrtoid species than do Palaeozoic ones. Although this method of approximate age determination was questionable, as was underlined by Tan in 1931, it was still being used, in a somewhat elaborated way, for example, by Kobayashi & Kimura in 1944. Reports of the end of the 19th century are essentially descriptive, and the studied samples are often undated because the absence of any other fauna. The modern phase of Mesozoic radiolarian stratigraphy started with Khabakov (1937), who understood that the seemingly extended stratigraphic ranges of many taxa were the repercussion partly of the unnatural taxonomic system, and partly of mistaken age-determinations of strata. Researchers used Haeckelian systematics for decades (*e.g.* Campbell & Clark 1944; Campbell 1954). Since the work by Riedel on Cenozoic material (1952, 1953) revealed the Haeckelian system inappropriate, it became clear that the taxonomic system for Mesozoic radiolarians would have to be reconsidered and that it is disjunct from that for the Cenozoic (Riedel 1967b). Indications for a sudden change in fauna at or near the Cretaceous/Paleocene boundary are documented by Lipman (1952) and Foreman (1968) resulting in ensuing large numbers of new genera and several new families being described for the Mesozoic (Foreman 1968; Dumitrica 1970; Pessagno 1969a, b, ...). During the 1960's, some stratigraphic charts were published for Cretaceous radiolarians, but these were generally of local applicability. Zhamoida (1972) compiled a summary of Mesozoic radiolarian occurrences in the "Pacific mobile belt", and Zhamoida & Kazintsova (1981) reviewed Mesozoic radiolarian literature appearing between 1967 and 1978. In the 1970's, the Deep Sea Drilling Project (DSDP) afforded the chance to correlate the evidence between continental and marine localities, making possible the construction of stratigraphic charts of wide applicability, and also allowing the calibration of radiolarian occurrences with calcareous microfossil groups zonations.

Triassic

Despite the great diversity existing among Upper Norian and Rhaetian radiolarians, relatively few taxa have been described.

World (excluding Europe)

Pacific, Atlantic, Indian. None.

America. Some earlier studies in North America were published by: Martin *et al.* 1915, and Smith 1916. A new set of studies was initiated on western North America by Pessagno *et al.* (1979) in Baja California. Pessagno & Blome (1980) studied the evolution of pantanelliid radiolarians and described species of several other genera from the upper Norian on Queen Charlotte Islands. Blome (1984a, b) further studied this fauna, described new species and proposed a preliminary radiolarian zonation for the Upper Triassic of western North America with the topmost Triassic subzone, the Betraccium deweveri Subzone, based on upper Norian faunas of Monotis age from the same locality. Further investigations in the Queen Charlotte Islands were undertaken by Carter (1990, 1993) who also studied the diverse Rhaetian fauna from the Sandilands Formation and proposed three preliminary radiolarian assemblages. Subsequent studies have included documentation of the Triassic-Jurassic boundary in northern Queen Charlotte Islands (Tipper & Carter 1990), evolutionary trends in latest Triassic and earliest Jurassic faunas (Carter 1994; Tipper *et al.* in press) and a phylogenetic study of the genus Ferresium (Carter 1992). In the northern Cache Creek Terrane of southern Yukon, Canada, upper Norian radiolarians have been reported from a chert sample by Cordey *et al.* (1991). Elsewhere in western North America, Blome, Reed & Tailleur (1989) found upper Norian radiolarians. Yeh (1989) studied radiolarians in the upper part of the Fields Creek Formation, east-central Oregon. His fauna (sample FC35) is suggested to be Lower Jurassic, but it compares closely with radiolarians from the Sandilands Formation and is more likely Rhaetian according to Carter (1993) who described and illustrated much of the Rhaetian fauna of the Queen Charlotte Islands.

SE Asia (Japan, Indonesia). In Indonesia Hinde (1908) investigated well-preserved radiolarians from a number of Moluccan localities (notably on Roti and Savu) which he believed to be Triassic, and described some eighty species, predominantly spherical and elliptical forms, multi-segmented cyrtoids, together with some closed cyrtoids and three-armed spongy forms. Brouwer (1921) believed this assemblage to be Late Jurassic. In the Phillipines, more recently Cheng (1989) illustrated upper Norian radiolarians from bedded chert of Uson Island. Further studies in this area by Yeh (1990; 1992) and Yeh & Cheng (1996) indicate that, in addition to faunas of late Ladinian and late Carnian age, two radiolarian assemblages dated as late Norian and

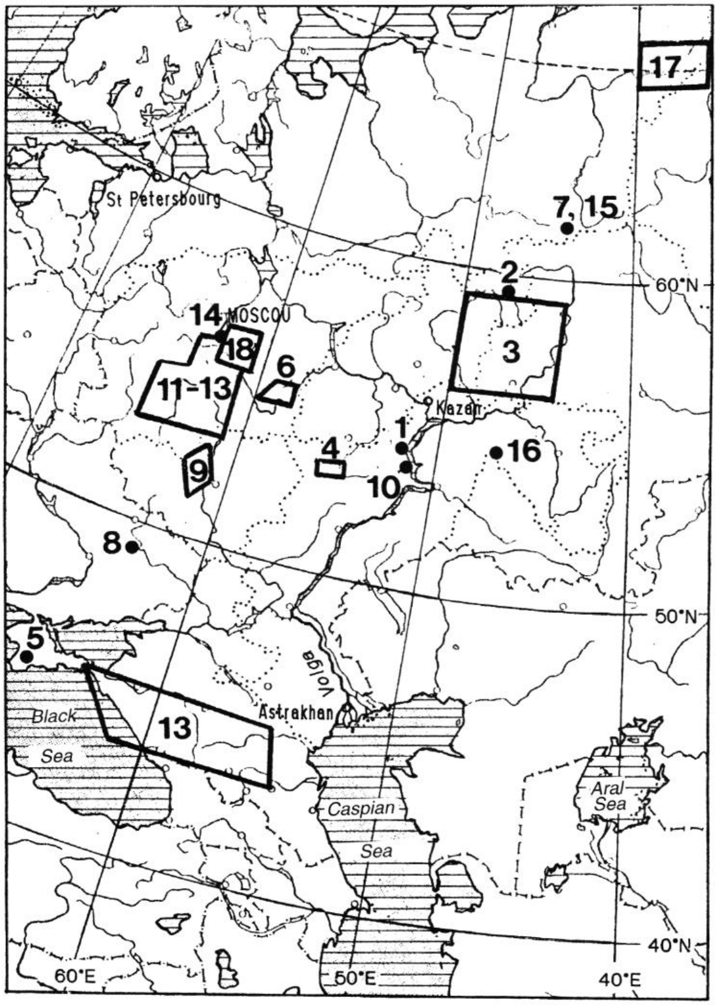

FIG. 1. — General map of eastern Peri-Tethys domain showing the investigated regions listed on table 1. Main areas of investigation are marked with zones. The numbers refer to those given on table 1. Detail maps are provided on Figs 2, 3.

TABLE 1. — List of publications dealing with Mesozoic strata of the Russian platform. Each publication has a number which corresponds to that on figures 1-3. For each publication, the age, region, latitude and longitude, subject of investigation, paleoenvironment and other involved fossil groups are provided.

n°	Author	Age	Region	Longitude Latitude	Subject of investigation	Paleoenvironment	Other group of fossils
1	Kariski 1889 *in* Petrushveskaya 1986 p.144	K2 st	Simbirsk (Uljanovsk)	48°15'E, 54°25'N	Presence of rads was established	Rads ooze from "santonian clay"	no information
2	Khudyaev 1931	J2 cl. J3 km-K1 nc	Povolgie Sysola Riv. Bas.	52°20'E, 59°35'N 49°30'-52°30'E, 60°00'-61°00'N	Rads from phosphate F° 49 sp., (with 20 n.sp.)	Marginal sea	Ammonites
3	Khabakov 1937	J3-K1 nc	Basin Vjatke Riv. Basin Kama Riv.	50°00'-53°00'E, 56°00'-61°00'N	Rads from 2 horizons: Volgian and Neocomian 94 gen. & species	Upwelling zone	Ammonites
4	Lipman 1952	K2 st-cp	Kuznezk district of Penza region	47°00'-48°00'E, 53°20'-53°50'N	Descript. of 48 sp. with 37 n.sp.	Moderate water	Forams
5	Gorbachik & Druchziz 1959	K1 al	Crimea	34°15'E, 45°20'N	Presence of rads in clay	Shallow water	Forams
6	Aliev & Smirnova 1969	K1 al	Vladimir district	40°10'-41°30'E, 55°15'-56°30'N	Presence of rads in clay	Shallow water	Forams
7a	Kozlova 1971	J3 km	Pechora basin	57°E, 62°N	First quotation of rads list of 6 n.sp.	Shallow water	?
7b	Kozlova 1976	J3 V	??	??	numerous rads, 1 n.sp.	Shallow water	?
8	Gorbunov 1971	K1 al	Slavjansk	37°30'E, 49°00'N	badly preserv. rads from clay and sand	Shallow water	no data
9	Sichera & Semenov 1982	K2 st	Voronezh	38°00'-39°00'E, 51°30'-52°00'N	well preserved rads in sand	altern. shallow & moderate waters	no data
10	Bragina 1987	K2 st	Uljanovsk	48°00'E, 54°00'N	*id.*	*id.*	no data
11	Vishnevskaya 1987	K1 al-K2 cp	1-Moscow 2-Vladimir 3- Brjansk	37°00'-39°00'E, 55°00'-55°30'N 39°00'E, 56°00'N 35°E, 54°-55°N	Biozonation	Moderate water depth	1- *Inoceramus* 2- Forams 3- Forams in K1 al
12	Vishnevskaya & Kazinsova 1990	K1-2	Central Russian platform	30°-50°E, 40°-60°N	Comparison of rad. biozones	no info.	no info.
13	Vishnevskaya 1993	K1-K2	1-Moscow 2-Precaucasus	37°-39°E, 55°00-55°30'N 37°-40°E, 44°30'-45°30'N	Rads zonation + illustration	Moderate water-depth	Forams
14	Bragina 1994	K2 t-cp	Khotkovo of Moscow district	37°30'E, 55°30'N	Rads stratig.	?	*Inoceramus*
15	Kozlova 1994	J3 km	Pechora	57°30'E, 62°30'N	presence of rads	no info.	Macrofauna
16	Amon & De Wever 1994	K2	Povolgie	50°-60°E, 50-°60°N	Comparison of biozones	shallow water	Forams
17	Amon 1985	K2 t-cp	Usa river	57°-67°E, 66°-67°N	Rads biozone	shallow water	
18	Kazinsova & Olferiev in press	K1 al	Moscow region	37°-39°E, 55°N	Rads from "Paramonov" clay	shallow water	Forams

early Rhaetian are present also.
In New Zealand, radiolarians from Kapiti Island (Torlesse Terrane) studied by Blome, Moore, Simes & Watters (1987) are coeval with upper Norian faunas from the Monotis beds at Kunga Island. In the Waipapa Terrane, Aita (in Sporli & Aita 1988) figured a mixed fauna of Upper Triassic and Lower Jurassic Tethyan radiolarians from the red chert of Kawakawa Bay. Further references to this fauna and its use in solving complexities of terrane accretion in New Zealand are found in Sporli, Aita & Gibson (1989).
From Japanese cherts Yehara (1927) illustrated six rather nondescript circular forms from Shikoku. Other localities (Kimura 1944a, b) suspected to be Triassic yielded poorly preserved circular radiolarians, spongy forms with three arms, and closed cyrtoids. Since the late 1970's a number of radiolarian zonal schemes for the Upper Triassic have been proposed by workers in Japan. Amongst these Yao, Matsuda & Isozaki (1980) established three successive radiolarian assemblages of Middle Triassic to Early Jurassic age from continuous sequences of chert in the Inuyama area, central Japan. The lower assemblage is Middle Triassic; the middle one is Late Triassic, and the upper one is Early Jurassic. The Late Triassic assemblage was later separated into three sub-assemblages (Yao *et al.* 1980); the upper two of these were proposed for late Norian and Rhaetian forms, respectively. Numerous undescribed taxa were also figured at this time. In 1982, Kishida & Sugano established five assemblage zones for Triassic strata from the Chichibu Belt in the Kochi and Oita Prefectures, Japan. Kishida & Hisada (1986) renamed and subdivided some of their assemblages. Matsuoka figured upper Norian radiolarians from the southern subbelt of the Chichibu Belt, Kochi Prefecture (1983b) and discussed faunas from the Togano Group (1984b).
Subsequently Sato, Murata & Yoshida (1986) established the Betraccium deweveri Zone for upper Norian strata in the southern part of the Chichibu Terrane in Kyushu. Yoshida (1986) examined a Late Triassic to Early Jurassic bedded chert sequence in Kagamigahara City, Gifu Prefecture, central Japan, and subdivided it into seven radiolarian zones.
Also noteable are the works published by Ishida (1983), Kishida & Sugano (1982), Kojima (1982), Matsuda & Isozaki (1982), Nakaseko & Nishimura (1979a, b), Takashima & Koike (1982), Yao (1972, 1979, 1981, 1982a, b, 1983, 1986), Yao, Matsuoka & Nakatani (1982). In northern China, in initial studies of radiolarians from the Nadanhada Range, Kojima & Mizutani (1987) figured upper Norian and Rhaetian taxa from Triassic bedded chert. Subsequently, Kojima (1989) discussed the accretionary history of terranes along the continental margin of East Asia during Mesozoic time using Middle and Upper Triassic radiolarian assemblages (including some upper Norian and Rhaetian taxa) to point out similarities between the Nadanhada-Western Sikhote-Alin Terrane, and the Tamba-Mino-Ashio Terrane of southwest Japan. Implications are that the Nadanhada Range is the northern extension of the Japanese terrane. The history of this Mesozoic superterrane is further discussed by Mizutani, Shao & Zhang (1990) along with similar tectonostratigraphic terranes in the Ryukyu arc, the Philippines and probably Borneo. A more recent paper by Yang & Mizutani (1991) outlines the geology and biostratigraphy of the Nadanhada Terrane, presents preliminary revision of parasaturnalids, and describes new parasaturnalid taxa of latest Triassic and early Jurassic age.
In eastern Russia, Triassic faunas in the Sikhote-Alin Terrane, Sakhalin Island (Verchojan areas), and the Koryak Upland were studied by Bragin (1986, 1991a, b, 1994). Radiolarians and conodonts of mid Early Triassic to latest Triassic age (including late Norian and Rhaetian faunas) are present in chert sequences at Sikhote-Alin where seven radiolarian zones and seventeen conodont zones have been established. These forms are discussed and illustrated and new taxa are described. Goltman (1969) listed radiolarian genera occurring in the Triassic of Pamir, but until they are illustrated a comparison with other fauna is impossible. Among other publications from Asia one can also mentioned the works by: Bailey & Mc Callien (1953); Hudson *et al.* (1954); Ichikawa (1950); Kimura (1944a, b); Kobayashi & Kimura (1944b); Scrivenor (1929); Yehara (1927); Zhamoida (1958).

Europe (excluding the Russian platform)

Records of radiolarians are still relatively rare in Triassic sedimentary rocks if the variety of levels involved is considered. In fact, most of the information available to date has been obtained from Alpine faunas.

Triassic radiolarians have been recognised for a long time but comprehensive studies are quite recent. Indeed, following a preliminary note in 1887, Rüst recorded in 1892 about twenty species from twenty-eight Triassic samples of central European hornsteins and calcareous limestones. In the same year, Parona figured about a dozen poorly preserved forms including some with circular and elliptical outlines together with apparently spongy forms with three and four arms. Cyrtoids, of which some are multisegmented and conical and others with inflated middle and lower sections and apparently closed, tubular prolongations are also documented by Parona (1892). Wirz (1945) illustrated a few circular and chambered radiolarians in thin sections of dolomite from south of Lake Lugano (Italy). Most of these assemblages are not sufficiently well-described to permit comparison with faunas described in more recent papers. Following some other minor studies (Winkler-Hermaden 1934; Andrusov 1950), a renewal will come from several Austrian sequences of clays and limestones, Kozur & Mostler (1972) described some fifty well-preserved radiolarians belonging to the emended Coccodsicids, astracturids, heliodsicids, saturnalids and veghicyclids. In their study of Middle and Upper Triassic radiolarians, Kozur & Mostler (1981), Kozur (1984a, b) described a great number of new species and new genera from the Potschenkalk (Sevat) and Zlambach marls (Rhaetian) of Austria. Lahm (1984) figured Middle and Upper Triassic taxa from northern Italy and Austria; some of these ranging upward into the Sevat and Rhaetian. During the 1970's and 1980's there was a renewal of interest on these levels (from Greece, Sicily and Turkey: De Wever *et al.* 1979; De Wever 1982a, b; from Austria and Northern Italy: Donofrio & Mostler 1978; Kozur & Mostler 1978, 1979a, b, 1981, 1983, and subsequent work; from the Carpathians: Dumitrica 1977, 1978a, b; Dumitrica *et al.* (1980); from Yugoslavia: Gorican & Buser 1990; from northern Italy: Lahm, 1984 ...).

Samples yielding radiolarians are rare and localities wide-spread but, in Europe, mainly concentrated in the Tethyan realm: from Austria, Italy, Slovenia, Serbia, Montenegro, Albania, Greece and Turkey. Most of the Triassic bioevents have been inter-correlated and calibrated with Conodonts or Ammonites or Pelecypods. No well-preserved and comprehensively described Boreal or sub-Boreal faunas are known in sufficient number to be able to be considered as representative. Only recently some faunas have been recorded in Russia from northern Siberia (Egorov & Bragin 1995).

This synopsis illustrates that radiolarian workers around the world have shown a renewed interest in upper Norian and Rhaetian faunas since 1980, and that the tempo of research has accelerated quite rapidly in the past five years. Despite this intensity, the majority of the Rhaetian fauna remains undescribed.

JURASSIC

World (excluding Europe)

Pacific, Atlantic, Indian. None besides the paper from Colom (1954) in the Atlantic Ocean.

America. Following some preliminary work by Bonet & Trejo (1956), Riedel & Schlocker (1956) and Smith (1916), the first substantial papers dealing with Early Jurassic radiolarians from Northern America were published by Pessagno and his collaborators (Pessagno & Blome 1980, 1982; Pessagno & Whalen 1982) and more recently by Yeh (1987). In the Caribbean apparently only one questionable paper by Vermunt (1937) can be quoted. Mattson & Pessagno (1979) reported Late Jurassic and Early Cretaceous radiolarians in Puerto Rican cherts and limestones. Pessagno (1977b) was able to erect a radiolarian zonation for the Late Jurassic, on the basis of forms occurring in cherts and limestone nodules in California.

SE Asia (Japan, Indonesia, Far East Russia). In the circum-Pacific region, Hinde (1917) listed poorly preserved Late Jurassic radiolarians in cherts from several localities in the Celebes.

Some general quotations of Jurassic radiolarians in SE Asia may be found in Bailey & Mc Callien (1953), Hudson *et al.* (1954), Huzimoto (1938), Kawada (1953), Khabakov (1932, 1937), Khudyoev (1931), Kimura (1944a), Kobayashi (1935), Tromp (1947, 1948), Yehara (1927), Zhamoida (1972), and from Indonesia in Brouwer (1921), Hinde (1917), Krumbeck (1922) and Vogler (1941). Coomaraswanny (1902) recorded the presence of Jurassic radiolarians together with plant remains in India. A broad summary of Late Jurassic and Cretaceous radiolarians, with a definition of seven distinct assemblages, was provided by Nakaseko & Nishimura in 1981. Since then recent workers are elucidating Japanese occurrences such as Aita (1982), Mizutani (1981), Matsuoka (1982a, 1983a) and numerous other workers.

Europe (excluding the Russian Platform)

The pioneer work on Late Jurassic radiolarians was based on Italian and Swiss localities. Rüst (1885) provided the original descriptions of assemblages from jaspers, flints and siliceous shales from a number of localities in the Allgau (southern Germany) and Austria (Urschlau) and from redeposited pebbles in western Switzerland. He also obtained rich assemblages from coprolites from iron mines at Ilsede, further north in Germany (near Hannover). This important paper presented seventy-two species dated as Late Lias-Early Dogger by associated ammonites. Rüst (1885) also recorded radiolarians in the Tithonian (Aptychus beds) from the Alps, in the flysch of Teisendorf (in the Achatal), in the flysch from Traustein (Upper Bavaria) and also from Neocomian levels of the Carpathians near Podbiel. Wisniowski (1889) described moderately preserved forms in siliceous concretions from the vicinity of Krakow, Poland.

Italian authors described diverse assemblages from flint nodules in limestones at Cittiglio (Parona 1890), and radiolarite and siliceous shales at Spezia (Vinassa 1898a, b, 1899), Monginevro (Squinabol 1913) and the Bolognese (Neviani 1900). Cayeux (1896) reported calcitized radiolarian skeletons in Tithonian limestones in the region of the Ardeche in southern France. Cayeux (1897) mentioned poorly preserved Jurassic radiolarians (Sch. inflata ammonite Zone) in the "Gaize" from Argonne, from Cher (France).

Muzavor (1977) described well-preserved radiolarians from siliceous marl at Oberaudorf (Bavaria). Steiger (1981) illustrated well-preserved forms from limestone turbidities in the vicinity of Salzburg. From broadly based studies of Tethyan assemblages the first radiolarian biozonations for Europe were made by Baumgartner *et al.* (1980) and Kocher (1981).

Radiolarian biostratigraphic schemes for Jurassic and Cretaceous sequences were proposed by Tikhomirova (1984, 1987) and Kazinsova (1984) for the Carpathians and the Lesser Caucasus, but, as these investigations are based on thin sections they are out-of-date and probably inaccurate.

Other early papers dealt with Jurassic levels from Western Europe (Andrusov 1950; Anonymous 1959; Bergounioux 1950; Cayeux 1891, 1896; Downie 1956; Cita 1965; Dacqué 1933; Deflandre 1953; de Lapparent 1925; Dunikowski 1882; Furrer 1951; Geyer 1961; Heitzer 1930b; Jacob & Nicorici 1957; Innocenti 1927; Jaccard 1909; Jodot 1931; Kraus 1914; Leischner 1961; Pantanelli 1880, 1887-1889; Parona 1892; Protescu 1933; Rüst 1885, 1898; Sido & Sikabonyi 1953; Termier & Maury 1928; Trauth 1950; Vadasz 1952; Vinassa 1898a, b, 1899; Weynschenk 1950, 1951; Winkler-Hermaden 1934). Data for Jurassic radiolarians are numerous in folded Tethyan terranes and radiolarians are the main constituents of the rocks for numerous Late Jurassic localities (in all the radiolarite type facies). A large number of papers have been published during the last two decades including: Baumgartner 1980; De Wever 1982a, b; De Wever *et al.* 1986b; Dumitrica 1970; Gorican 1994, ...

The first biostratigraphically significant papers dealing with Early Jurassic radiolarians were published recently from Tethyan realm (Pessagno & Poisson 1981; De Wever 1981a, b, 1982a; De Wever & Origlia-Devos 1982; Gorican 1994).

An available set of stratigraphic markers can be based on some recent work (Gorican 1987, 1994) and on the synthesis published by the InterRad group (1995). In spite of the abundance of work published during the two last decades, most of them deal with the Tethyan realm and almost no significant publications relate to the true Boreal realm. No well preserved Boreal or sub-Boreal faunas are described in the literature and only some radiolarian species are mentioned in very sparse localities [Scotland: Dyer & Copestake 1989 and Russia: Khabakov 1937 (illustration of the latter is too poor to be useful), and more recently Bragin (1994) and Bragin & Bragina (1995)]. Therefore, at present, there is no reliable general datum available to use for the Boreal province.

No warm *vs* cold faunas have been identified with confidence to date in western Europe. This is mainly due to the fact that much of the currently available information has been gathered from radiolarite-type facies and that this type of sedimentary rock was deposited under the most active parts of upwelling systems (see above De Wever *et al.* 1994).

Cretaceous

World (excluding Europe)

Some general reports (by topic or by location) were published by Krasnyi *et al.* (1962), Rüst (1887), Socco (1905) and, in Africa, by Magné & Sigal (1953).

Pacific, Atlantic, Indian. Several studies based on DSDP material have contributed to the taxonomic and stratigraphic understanding of Early Cretaceous radiolarians (Moore 1973; Riedel & Sanfilippo 1974; Foreman 1975). DSDP sequences from the North and Central Pacific have contributed very substantially to Middle and Late Cretaceous stratigraphic zonation (Foreman 1971, 1975; Schaaf 1981) and for a predominantly taxonomic study by Empson-Morin (1981). Late Cretaceous radiolarian stratigraphy in the Eastern Atlantic has been aided by the Deep Sea Drilling Project (Petrushevskaya & Kozlova 1972; Foreman 1978b). DSDP sequences drilled in the eastern Atlantic provided information on radiolarian stratigraphy in that region (Foreman 1978b; Basov *et al.* 1979, for the Early Cretaceous). Foreman (1977) summarised occurrences in the Atlantic Ocean and its borderlands, and refined the Late Cretaceous zonation of that region. DSDP cores from the eastern Indian Ocean provided the basis for the description of three stratigraphically significant assemblages in the Middle and Late Cretaceous (Renz 1974). Moderately preserved Late Cretaceous radiolarians are recorded in Indian Late Cretaceous phosphatic nodules by Garg & Jain (in press).

America. Among some of the earliest works conducted in North America one can cite: Bolin 1956; Campbell & Clark 1944; Crandell 1952; Eicher 1960; Foreman 1966; Göke 1959; Hinde 1894; Nauss 1947; Payne 1962; Ransome 1894; Riedel & Schlocker 1956; Rubey 1929; Rüst 1892, 1898; Searight 1938; Tyrrell 1890; Woodward & Thomas 1885, 1895; and for South America: Galavis 1951; Richter 1925; Stainforth 1948; Thalman 1946; and for Caribbean: Ayala-Castanares 1959; Brönnimann & Rigassi 1963; Foreman 1966; Palmer 1934; Pessagno 1960, 1962, 1963; Vermunt 1937. The circum-Pacific region is represented by descriptions of radiolarian assemblages from the Cenomanian of California (Pessagno 1971a) and of Costa Rica (Schmidt-Effing 1980).

Radiolarians are recorded in Campanian limestones of Puerto Rico (Pessagno 1963), and as pyritized skeletons in the Late Cretaceous of Venezuela (Galavis 1951). Also, in the Caribbean region, the Deep Sea Drilling Project has provided data on Late Cretaceous radiolarian stratigraphy (Sanfilippo & Riedel 1976). Mid-Cretaceous radiolarians were reported by Basarovski (1991) from Central America (Cuba).

For North America, the earliest record of Cretaceous radiolarians is from the Pierre shale of Manitoba, by Rüst (1892, 1898). Occurrences of Albian and Campanian radiolarians in Alberta were recorded by Wall (1975). Campbell & Clark (1944) described a diverse Campanian assemblage from California, and a sparse Franciscan assemblage was recorded by Riedel & Schlocker (1956). Californian assemblages were exploited to greater stratigraphic advantage by Foreman (1968) and Pessagno (1970, 1971a, 1972, 1973 and 1976). The paper last cited established eight Late Cretaceous radiolarian zones in California, and described a substantial number of new taxa. Pessagno (1977b) proposed a Berriasian to Albian zonation and a large number of new taxa on the basis of assemblages from calcareous nodules from a number of Californian localities.

E Asia (Japan, Indonesia, Far East Russia). The first investigation of Early Cretaceous radiolarians in the circum-Pacific belt was conducted by Hinde (1900), who investigated them in numerous samples of cherts, marls and limestones from Central Borneo. From the Cretaceous chalks on the Indonesian island of Rotti, Tan Sin Hok (1927) described a diverse, well-preserved assemblage that is now believed to be between Albian and Turonian in age (Riedel & Sanfilippo 1974). Nakaseko *et al.* (1979b) distinguished a number of stratigraphically significant assemblages through the Cretaceous and Palaeogene of Japan, and compared them with zonal schemes developed for deep-sea sequences. A more recent compilation of the stratigraphy of Japanese Middle and Late Cretaceous radiolarians, defining zones and a number of new taxa, was produced by Taketani (1982).

Descriptions of radiolarian assemblages from the Cenomanian of Sakhalin include Kazintsova (1981). Among others, the following works were published: Aliev 1961a, b, 1965; Dundo & Zhamoida 1963; Hudson *et al.* 1954; Karitskii 1889; Khabakov 1932, 1937; Khudyaev 1931; Kozlova & Gorbovets 1966; Lipman 1952, 1960; Mittermaier 1896; Nakaseko *et al.* 1965; Rao 1932; Vassoevich 1938. From Australia and New Zealand publications include: Crespin 1946, 1960; Dun *et al.* 1901; Etheridge & Dun 1902; Hinde 1893; Foreman 1966. From Indonesia: Brouwer 1921; Foreman 1966; Tan 1927; Vogler 1941. Berriasian blocks in a Turonian chert matrix yield well-preserved radiolarians from Tibet (Wu & Li 1982), and Dundo & Zhamoida (1963) investigated Valanginian radiolarians in siliceous volcanogenic rocks from the Far-Eastern USSR.

Nakagawa & Nakaseko (1977) listed and illustrated radiolarians from a Jurassic and an Early Cretaceous locality in Japan. A Late Cretaceous radiolarian occurrence in manganese carbonate ore in Japan is described by Yao (1979).

Europe (excluding the Russian platform)

As is the case for the Jurassic, most of the initial research on Early Cretaceous radiolarians was based on European material but today current investigations are more widely dispersed.

Coprolites and siliceous limestones from Zilli (Saxony) and Gardenazza (northern Italy) provided most of the Early Cretaceous forms described by Rüst in his paper of 1888, and ten years later he added forms from the cherty limestones of Cittiglio in northern Italy (Rüst 1898; see also Parona 1890). Fischli (1916) illustrated a diverse faunal assemblage from flints in a Swiss conglomerate. Sollas (1873) mentioned radiolarians in coprolites from the Cambridge Greensand and, 30 m below, in the Gault Clay from Bedfordshire (UK). *Quaterly Journal of the Geological Society* (p. 78)) and Grimes (1895: 345) described two species from the Lower Greensand of Surrey (UK). In 1883, Wallich recorded the presence of four genera of radiolarians in the cavities of hollow cherts from Surrey (UK). Fritsch (1893) recorded the presence of eleven species in marly beds of Prisen (Senonian) from Bohemia, and Deecke (1894) some radiolarians in chalks flints at Rügen. Hill & Jukes-Browne (1895) mentioned the presence of radiolarians in chalks of the Melbourne Rock (UK). Cayeux (1897) mentioned twenty-seven genera and described numerous species of Turonian radiolarians from SE, N and NW of the Paris Basin (France) and from smectite du Hevre (Belgium). Holmes (1900) recorded twenty genera and forty-one species from the chalk in Surrey (UK). Zittel (1876) described the first Cretaceous radiolarians from northern Germany, in spite of a poorly preserved fauna. Tethyan radiolarian assemblages of Middle Cretaceous age have been described by Squinabol (1914) from the Veneto region of Italy. Ravn G. (before 1911) mentioned the presence of Upper Cretaceous radiolarians in Arnager limestones (Island of Bornholm, Denmark).

Over the decades, Cretaceous radiolarians have been described from scattered localities (Andrusov 1950; Anonymous 1959; Colom 1954; Corti 1896, Custodis & Schmidt-Thomé 1939; Deecke 1895; Elbert 1902; Fric 1893; Furrer 1951; Grimes 1895; Heitzer 1930; Hill 1912; Hill & Jukes-Brown 1895; Holmes 1900; Jodot 1931; Lombard & Schröder 1939; Neviani 1900, 1901; Pantanelli 1880, 1887, 1889;

Parona 1890; Perner 1891; Protescu 1933; Rüst 1887, Squinabol 1903, 1904, 1914; Sujkowski 1931; Vasicek 1947; Vinassa 1901; Vinassa 1900; Wallich 1883; Wetzel 1933, 1961). In the 1960's evidence accumulated for an abrupt evolutionary change at or near the Cretaceous/Palaeocene boundary (Lipman 1952; Foreman 1968), and consequently, large numbers of new Cretaceous genera and several new families have been described (*e.g.* by Cita 1965; Foreman 1966, 1968; Dumitrica 1970; Herm 1962; Empson-Morin 1981).

Baumgartner *et al.* (1980) proposed a preliminary stratigraphy based on a number of widely scattered radiolarian assemblages from the Tethyan region. Boyanov & Lipman (1973) were able to use a poorly preserved radiolarian assemblage to determine the Early Cretaceous age of Bulgarian siliceous shales previously considered to be Palaeozoic, and Lozynyak (1969) recorded assemblages of this age from the Ukrainian Carpathians. In the Kuznetsk area of the Russian Platform, Lipman (1952) recorded numerous radiolarian taxa in samples from drilled wells. Goltman (1971, 1975) recorded occurrences in limestones and marls of the Tadjiksk Depression, culminating in a useful stratigraphic compilation (Goltman 1981). Lipman (1960) described numerous assemblages of Coniacian to Danian age in wells and surface exposures of the Western Siberian Lowland, and Kozlova & Gorbovets (1966) described characteristic complexes for the Turonian to Campanian deposits of that region.

Tethyan radiolarian assemblages of Middle Cretaceous age have been described by Kozlova in Basov *et al.* (1979) from a DSDP Site off Spain, and by Dumitrica (1970, 1975) from Romanian marls and radiolarite.

In spite of the abundance of work published during the two last decades, most of them deal with the Tethyan realm and almost no significant papers consider the true Boreal realm. No well preserved Boreal or sub-Boreal faunas are described in the literature. Some species are only recorded rarely from very isolated localities and therefore there is no available datum to use in confidence for the Boreal province and we have chosen to omit such datums from the Cretaceous chart. Biostratigraphic data exists in a series of papers among which the most significant are Jud (1994) for the zones in Early Cretaceous, Erbacher (1994) and O'Dogherty (1994) for the middle part of Cretaceous, Sanfilippo & Riedel (1985) and Khoklova *et al.* (1994) for the Late Cretaceous together with Urquhart (1994) and Bragin (1995) for the Late Cretaceous of Cyprus. By the Late Cretaceous, the Tethyan environment for the accumulation of radiolarian sediments had practically disappeared, and a Palaeogene pattern was developing. The only substantial occurrences in the Mediterranean region are in the north Italian *Euganei* (Squinabol 1903, 1904), and in Greece (De Wever & Thiébault 1981). There are significant records in Senonian and Turonian shales of Czechoslovakia (Perner 1891), in Campanian chalks of northern Germany (Zittel 1876) and in France and Belgian Campanian silicified limestones (Cayeux 1897).

Danian-Palaeocene

Publications dealing with this time period are not numerous. Literature recording occurrences from Asia includes the following work: Hollis 1991; Vishnevskaya 1981-1988c; Basov & Vishnevskaya 1995; from the Atlantic realm: Saito *et al.* 1966; from the East Indies: Reinhard & Wenk 1951; from Europe: Anonymous 1959; Stoesche & Hiltermann 1940; Twerenbold 1955; Borisenko 1958, 1960, Kozlova 1993 and from North America: Frizzell & Middour 1951.

RADIOLARIAN STUDIES FROM THE RUSSIAN EUROPEAN PLATFORM

Khudjaev I. E. (1931) in a paper entitled "On the Radiolaria in the phosphates in the region of the Syssola River" described forty-nine species, belonging to ten genera, where twenty-eight species were determined as new. They are *Cenosphaera komiensis* n.sp., *C. syssolae* n.sp., *C.* sp. indet. N1, *C.* sp. indet. N2, *Carposphaera affinioides* n.sp., *Lithapium supraspinosum* n.sp., *Lithocyclia ovalis* n.sp., *Porodiscus* sp. indet. N1, *P.* sp. indet. N2, *Cornutanna ovalis* n.sp., *Dicolocapsa trapezoidalis* n.sp., *D.* sp. indet. N1, *D.* sp. indet. N2, *Tricolocapsa multipora* n.sp., *Phormocampe favosa* n.sp., *Dictyomitra multipora* n.sp., *D. spicularia* n.sp., *D. biporosa* n.sp., *Lithocampe syssolaensis* n.sp., *L.* sp. indet. N1, *L.* sp. indet. N2, *Cyrtocapsa rusti* n.sp., *Stichocapsa chabakovi* n.sp., *S. regularis* n.sp., *S. quadripora* n.sp., *S. kassini* n.sp., *S. zyrjanica* n.sp. and *S. wisingiana* n.sp.

Khabakov (1937) in his paper "Radiolarians from Lower Cretaceous and Upper Jurassic phosphorites of Vjatka and Kama River Basins" described nineteen genera and seventy-five species of radiolarians.

Lipman (1952) in her monograph "Materials on monographic study of Upper Cretaceous radiolarians from the Russian platform" described forty-eight radiolarian species, where thirty-eight were described as new species. They are: *Cenosphaera minor* n.sp., *C. mammilata* n.sp., *Cenellipsis elliptica* n.sp., *Xiphosphaera irregularis* n.sp., *Cromyodruppa concentrica* n.sp., *Cenodiscus lens* n.sp., *Spongoprunum crassum* n.sp., *S. angustum* n.sp., *S. articulatum* n.sp., *Trochodiscus spiniger* n.sp., *Triacticus triacuminatus* n.sp., *Porodiscus vulgaris* n.sp., *Stilodictya delicatula* n.sp., *S. placentalis* n.sp., *Tripodictya triacuminata* n.sp., *Euchitonia santonica* n.sp., *Hagiastrum crux* n.sp.,

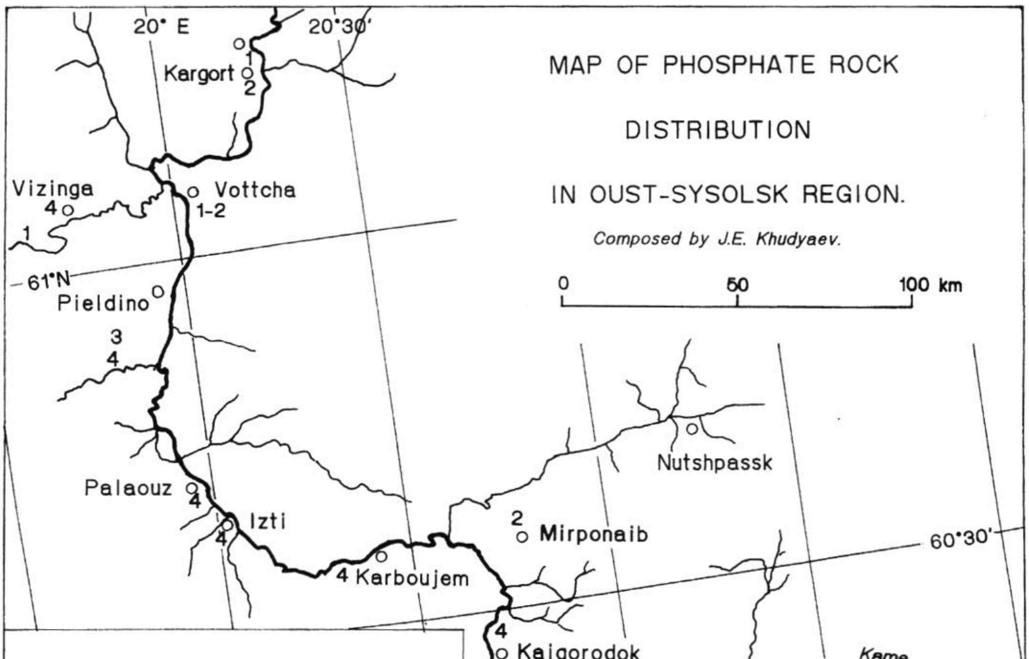

FIG. 2. — Location map of sites reported by Khudyaev (1931) in published investigations of Oust-Sysolk region (20°-21°E, 30°N).

Histiastrum cruciferum n.sp., *H. aster* n.sp., *H. membraniferum* n.sp., *H. irregulare* n.sp., *Tesserastrum quadratum* n.sp., *Rhopalastrum trigonale* n.sp., *R. tumidum* n.sp., *R. ingens* n.sp., *R. attenuatum* n.sp., *Spongodiscus impressus* n.sp., *Spongodiscus citrus* n.sp., *S. maximus* n.sp., *S. volgensis* n.sp., *Spongotripus aculeatus* n.sp., *Stylotrochus hexacanthus* n.sp., *S. dolichacanthus* n.sp., *S. actacanthus* n.sp., *Lithostrobus turritella* n.sp., *Dictyomitra scalaris* n.sp., *D. gigantea* n.sp., *D. striata* n.sp. All species derived from Santonian-Campanian clay of Penza region.

Aliev & Smirnova (1969) in their paper "New species of radiolarians from Albian of Central areas of the Russian platform" described from Upper Albian (40 m thick) clay, with Albian foraminiferas of the Vladimir district, six new species: *Porodiscus kavilkinensis* Aliev n.sp., *P. inflatus* Smirnova *et* Aliev n.sp., *Sethocyrtis mosquensis* Smirnova *et* Aliev n.sp., *Theocampe cylindrica* Smirnova *et* Aliev n.sp., *T. simplex* Smirnova *et* Aliev n.sp., *Stichocampe cuneatus* Smirnova *et* Aliev n.sp. and one subspecies *Dictyomitra ferosia* Aliev subsp. *angusta* Smirnova

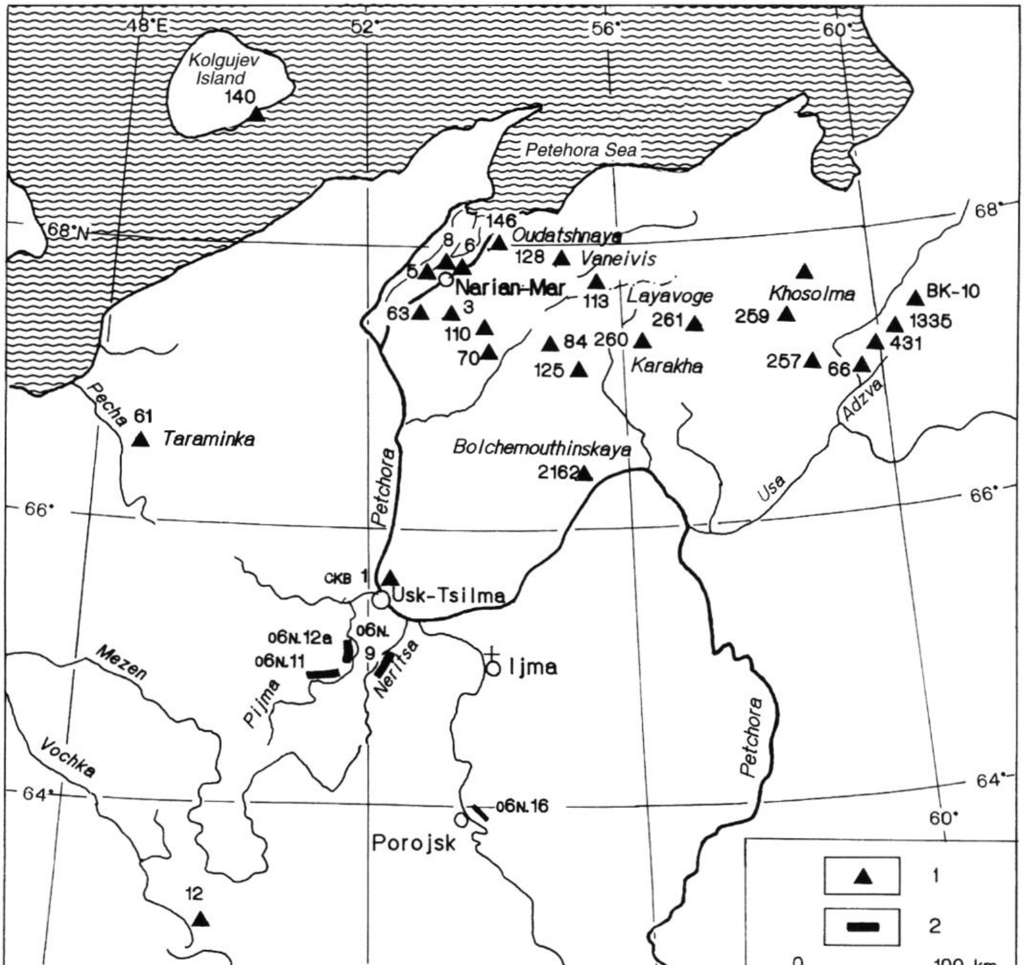

FIG. 3. — Location map of sites (drill holes -1- and outcrops -2-) reported by Kozlova (1994) in published investigations of Pechora (48°-60°E, 64°-69°N).

sub.n.sp. A number of forms from the Ukrainian Carpathians are described by Lozynyak (1969, 1975), and other forms from Azerbaidzhan are described in a series of papers by Aliev (1961a, b, 1965, 1969a, b) on Valanginian, Aptian, Albian and Cenomanian assemblages in which many of the radiolarians are calcitized.

Kozlova (1971) in her paper "About finding of radiolarians in the lower Kimmeridgian strata of the Timan-Urals region" reported the radiolarian assemblage from white marl strata of 10 cm thick with the ammonites *Amoeboceras kitchini* Salf, *Rasenia* cf. *trimera* Opp. The assemblage included seventeen species, where five species were new: *Stylosphaera* ? *asperalla* Kozlova n.sp., *Staurodictya retusa* Kozlova n.sp., *Hagiastrum crassum* Kozlova n.sp., *H. squama* Kozlova n.sp., *Spirema* ? *sphaerica* Kozlova n.sp. She emphasized that these newly discovered assemblages are similar to the Lower Cretaceous assemblages from Vjatka and Kama River Basins, previously described (Khudjaev 1931; Khabakov 1937).

A paper by Kozlova (1973) "New species from lower Kimmeridgian of the Timan-Urals region" gave the description of all new species listed in her previous paper (Kozlova 1971). Poorly-preserved Albian radiolarians from the Dnieper-Don Basin were reported by Gorbunov (1979).

Kozlova (1983) in her paper "Late Volgian radiolarians of USSR North" recognized three radiolarian assemblages: lower Kimmeridgian *Crucella crassa*, Volgian *Stichopilidium planocephala*, Berriasian *Hemicryptocapsa salymica* and described *S. planocephala* n.sp.

Kozlova (1994) in a paper entitled "Assemblages of Mesozoic radiolarians from the Timan-Pechora oil-bearing region" describes precise characteristics of four radiolarian assemblages: lower Kimmeridgian *Crucella crassa*, middle Volgian *Parvicingula papulata*, upper Volgian *Pseudocrolanium planocephala* and upper Berriasian-lower Valanginian *Hemicryptocapsa salymica*, which were partly described in her previous papers (Kozlova 1973, 1976). About twelve species were illustrated as new in this paper. Vishnevskaya (1993) in a paper "Jurassic and Cretaceous radiolarian biostratigraphy in the USSR" illustrated twelve species from Coniacian-Santonian strata from the Moscow district.

Bragina (1994) in her paper "Upper Cretaceous radiolarians and stratigraphy of Khotkovo Group, Moscow region" studied radiolarians in four sections and proposed two biostratigraphic units: Coniacian (?) - Campanian (*Archaeospongo-prunum bipartitum-Crucella irwini)* and Campanian (*Archaeospongoprunum hueyi-A. salumi)*. She counted more than 50% of Californian species among these Russian plate assemblages.

Vishnevskaya (1996) in a paper "Peri-Tethyan radiolarians and their implications" illustrated eighteen species from Albian-Santonian of the Moscow, Kaluga and Brjansk areas.

CONCLUSION

The improvement of a taxonomic system for Mesozoic radiolarians is hampered by a general lack of well-preserved specimens from well organised sequences which are needed to develop the basis for a reliable hypothesis of evolutionary links. This has represented an important factor in the approach chosen by some authors (*e.g.* Pessagno 1969a, b, 1971a, 1977b; Empson-Morin 1981, 1982; Kozur & Mostler 1972-1989) who produced a highly-split taxonomic hierarchy indicating all observed morphological characters. A highly-divided taxonomy is useful for the recognition of slight morphological variations which may eventually be comprehended as expression of paleoenvironmental conditions. This does not necessarily, however, advance the general aim of a taxonomy which considers phyletic relationships, and it often results in species which are too narrowly delimited to be broadly suitable for stratigraphic purposes. However, correlations are a primary phase in the move towards settling the succession of species on which a natural classification can be based. Fulfilment of these aims would allow a better appreciation of the paleobiodiversity of these organisms and provide a useful tool for measuring geological time.

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Zhiyuan T. & Tsorun T. 1976. — Studies on the Radiolaria of the East China Sea. *Studia Marina Sinica* 11: 217-310.

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TABLE 2. — Publications on Mesozoic radiolarians, with indications of the localities, involved ages and main topic (except publications dealing with European part of the former Soviet Union, see table 1).

LOCATION	AGE	TOPIC	AUTHOR
	Czc Mzc	Evolu.	Kellogg D. E. 1982
	Pzc Mzc	Gener. Strati Evolu.	Kling S. A. 1978
	Mzc Czc	Taxon. DSDP14	Petrushevskaya M. G. & Kozlova G. E. 1972
	Mzc	Taxon. Skelet.	Nakaseko K. & Yao A. 1973
	Czc Mzc?		Levykina I. E. 1984
	Czc Mzc Pzc	Taxon. Gener.	Moore R. C. 1954
	E.Cret.-L.Jur.		Khabakov A. V. 1937
	Cret.	Taxon. N.Sp.	Foreman H. P. 1966
	Mzc	Skelet.	Deflandre G. 1964
	Tr.	Taxon. N.Sp. Evolu.	Dumitrica P. 1978a
	Mzc Czc	General	Deflandre G. 1953
	Mzc	General Skelet. Morphogen.	Deflandre G. 1960
	Czc Mzc	Skelet. Growth Morphogen.	Deflandre G. & Deflandre-Rigaud M. 1958
	Mzc	Taxon. N.Sp.	Kozur H. 1979
	PCzc? Mzc?	Plankton	Meyen F. J. 1896
	Mzc Czc	Taxon. Evolu. Skelet.	Petrushevskaya M. G. 1981
	Mzc Czc	Taxon. Skelet.	Petrushevskaya M. G. 1986
	Mzc	DSDP26	Pessagno E. A. Jr & Michael F. Y. 1974
	Pzc-Czc	General Taxon. Biol. Strati	Goll R. M. & Merinfeld E. G. 1979
	Czc Mzc Pzc	Sedim. Review of papers	Hill W. 1912
	Mzc Czc	Taxon. Skelet.	Petrushevskaya M. G. *et al.* 1976
		Taxon. Skelet.	Petrushevskaya M. G. 1979
	Czc	Taxon. Skelet.	Petrushevskaya M. G. 1975b
	Czc Mzc	Skeleton Ontogen. Shape	Nishimura H. 1986
	Mzc Pzc	Taxon. Skelet.	Petrushevskaya M. G. 1975a
	L.Cret.	DSDP29	Pessagno E. A. Jr 1975
	Mzc Czc	Taxon.	Petrushevskaya M. G. 1975c
	Jur.Czc.	Taxon.	Dumitrica P. 1988
	Late Cret.	Taxon. Evolu.	Empson-Morin K. M. 1982
	Cret.	Taxon. Strati	Sanfilippo A. & Riedel W. R. 1985
	M.Cret. Recent	Skelet.	Thurow J. & Anderson R. O. 1986
	Jur.	Taxon. Skelet.	Takemura A. 1986
	Mzc Czc	Taxon.	Riedel W.R. 1967a
	Czc	Taxon.	Riedel W. R. 1967b
	Mzc	Strati Taxon.	Tshedia D. M. 1985
	Cret.	DSDP7	Foreman H. P. 1971
	Mzc Cret.	Strati Taxon. DSDP20	Foreman H. P. 1973b
	Cret. Czc	Taxon. Evolu.	Dumitrica P. 1985
	Pzc-Czc	Taxon.	Dumitrica P. 1984
		Technic. SEM Taxon.	De Wever P. 1980
	Mzc	Evolu. Biol.	Doderline L. 1887
	Pzc-Czc	Gener. Taxon.	Dumitrica P. 1979
	Pzc Mzc	General Taxon.	Foreman H. P. & Riedel W. R. 1972
	Cret.-Czc	Taxon. Strati DSDP10	Foreman H. P. 1973a
		Taxon.	Cordey F. *et al.* 1988
	Czc Mzc?	DSDP1	Ewing M. *et al.* 1969
	Mzc Czc	Taxon. Gener.	Deflandre-Rigaud M. 1969
Africa Algeria	Cret. Alb.-Cenom.		Magné J. & Sigal J. 1953
Amer. N.England, Austral. California	Pzc Mzc		Blake M. C. Jr & Murchey B.L. 1988

LOCATION	AGE	TOPIC	AUTHOR
Amer.C.	Mzc	Taxon. DSDP	Pessagno E. A. Jr & Longoria T. J. F. 1973
Amer.C.	Earl.Cret. Mzc		Alcocer V. M. D. 1960
Amer.C. Calif. Mexico (B. California)	L.Tr.	Strati Taxon.	Pessagno E. A. Jr *et al.* 1979
Amer.C. Carib. Bahama	Mzc	DSDP1	Pessagno E. A. Jr 1969
Amer.C. Carib. Cuba	Mzc		Vishnevskaya V. S. *et al.* 1982
Amer.C. Carib. Venezuela	Jur.-Cret.	Strati Ophiol.	Beck C. *et al.* 1984
Amer.C. C. Rica, Tethys, Greece, Italy	L.Jur.-Earl.Cret	DSDP	Devos I. 1983
Amer.C. Costa Rica Indian Tethys Greece Italy (Sicily)	Jur.-Cret.	DSDP Taxon. Strati	Origlia-Devos I. 1983
Amer.C. Costa Rica,	Earl.-Mid.Jur.	Strati Taxon.	De Wever P. *et al.* 1985a
Amer.C. Costa Rica		Strati Ophiol.	Bourgois J. *et al.* 1982
Amer.C. Costa Rica			Wildberg H. *et al.* 1982
Amer.C. Costa Rica Nicoya		Strati Ophiol. Radt	Schmidt-Effing R. 1980
Amer.C. Costa Rica Nicoya	Jur.-Cret.	Strati Ophiol.	Schmidt-Effing R. 1979
Amer.C. Costa Rica Nicoya	Cret.	Strati	Schmidt-Effing R. *et al.* 1980
Amer.C. Costa Rica Nicoya	Cret.	Strati Radt	Schmidt-Effing R. 1980
Amer.C. Costa Rica, Nicoya		Radt Ophiol. Sedim.	Gursky H.-J. & Schmidt-Effing R. 1983
Amer.C. Costa Rica Nicoya	Jur-Cret.	Radt Ophiol.	Steinberg E. 1988
Amer.C. Costa Rica Nicoya	M.-Cret.	Strati	Schmidt-Effing R. 1980
Amer.C. Costa Rica Nicoya	Mzc	Ophiol.	Gursky H.-J. 1988
Amer.C. Costa Rica NW. Nicoya	Jur.-Cret.	Strati Sedim.	Gursky H.-J. *et al.* 1982
Amer.C. Cuba.	Campan.	Strati	Florez Albin E. 1988
Amer.C. E.Mexico.	Tithonian	Taxon.	Yang Q. & Pessagno E. A. 1989
Amer.C. Puerto Rico	Jur.-E.Cret.	Taxon. Strati	Mattson P. H. & Pessagno E. A. Jr 1979
Amer.C. Tethys	Jur.-Cret.	Radt	De Wever P. *et al.* 1986a
Amer.C. W.Atlant. Blake Bahama	M.Jur.		Yamamoto H. *et al.* 1985
Amer.N.	Jur.	Taxon.	Pessagno E. A. Jr *et al.* 1989
Amer.N.	Tr.	Biozon. Taxon. Strati	Blome C. D. 1984b
Amer.N.	Jur.	Strati Zones	Pessagno E. A. Jr *et al.* 1987
Amer.N.	Mzc	Taxon. Strati Gener.	Campbell A. S. & Moore R. C. 1954
Amer.N. Alaska	Tr.	Biostr.	Blome C. D. *et al.* 1989
Amer.N. Alaska. USA	Earl.Mzc	Paleogeog. Envir.	Blome C. D. 1987
Amer.N. Calif. Franciscan	Jur.-Cret.	Strati	Davis E. F. 1918
Amer.N. Calif. ex-USSR Asia Japan Tethys Europe	Mzc	Bioz.	Vishnevskaya V. S. 1985
Amer.N. Calif.	Jur.-Cret.	Taxon.	Pessagno E. A. Jr 1973
Amer.N. Calif.	Cret. L.Maastrichtian	Taxon. Strati	Foreman H. P. 1968
Amer.N. Calif.	L.Jur.	Ophiol.	McLaughlin R. J. & Pessagno E. A. Jr 1978
Amer.N. Calif.	Czc Mzc?	Sedim.	Hinde G. J. 1894
Amer.N. Calif.	Tr.-Cret.	Taxon.	Pessagno E. A. Jr 1977c
Amer.N. Calif.	L.Cret.	Taxon.	Pessagno E. A. Jr 1971a
Amer.N. Calif. Carib. Bla.-Bahama Gr.Valley	Jur.-Cret.	Taxon.	Pessagno E. A. Jr 1971b
Amer.N. Calif. Coast Ranges	L.Jur.-Cret.	Strati Taxon.	Pessagno E. A. Jr 1977a
Amer.N. Calif. Franciscan		Taxon.	Riedel W. R. & Schlocker J. 1956
Amer.N. Calif. Franciscan Gr.Valley			Seiders V. M. *et al.* 1979
Amer.N. Calif. Fransciscan	Jur.	Radt Ophiol. Strati Lithol.	Murchey B. 1984
Amer.N. Calif. Gr.Valley Blake-Bahama	Cret.	Taxon.	Pessagno E. A Jr 1972
Amer.N. Calif. Gr.Valley California	L.Cret.	Strati Taxon.	Pessagno E. A. Jr 1976
Amer.N. Calif. Gr.Valley Franciscan	E.Cret.	Strati Taxon.	Pessagno E. A. Jr 1977b
Amer.N. Calif. Great Valley	L.Cret.	Taxon.	Pessagno E. A. Jr 1970

LOCATION	AGE	TOPIC	AUTHOR
Amer.N. Calif. Klamath	Perm.-Tr.	N.Sp. Paleoenvir.	Noble P. & Renne P. R. 1988
Amer.N. Calif. S.Klamath		Strati	Irwin W. P. *et al.* 1977
Amer.N. Calif. Tethys Europe (Italy, Spain, France)	Pzc-Czc	Skelet.	De Wever P. 1986
Amer.N. California,	M.-L.Jur.	Taxon.	Pessagno E. A. Jr & Blome C. D. 1982
Amer.N. California	L.Cret.	Taxon.	Campbell A. S. & Clark B. L. 1944
Amer.N. Canada (Br.Columb.)	Devon.-Jur.	Taxon.	Cordey F. & De Wever P. 1988
Amer.N. Can. (Br.Columb.) CacheCreek	Jur.	Strati	Cordey F. *et al.* 1987b
Amer.N. Can. (Br.Columb.) CacheCreek	Perm.-Jur.	Strati	Cordey F. *et al.* 1987a
Amer.N. Canada Alberta	Cret.		Wall J. H. 1975
Amer.N. Canada Queen Charlotte	Tr. (L. Nor.)		Carter E. S. 1988
Amer.N. Canada Queen Charlotte	Earl.-Mid.Jur.	Biostr. Taxon.	Carter E. S. *et al.* 1988
Amer.N. Canada Queen Charlotte	Earl.-Mid.Jur.	Biostr. Taxon.	Carter E. S. 1985
Amer.N. Can. Queen Charlotte (Kunga)	L.Tr.	Strati	Carter E. S. *et al.* 1989
Amer.N. Colorado, Kansas	Cret.	Strati Taxon.	Bergstresser T. J. 1983
Amer.N. E.Alaska	L.Tr.	NSG N.Sp.	Robinson B. E. & Pessagno E. A. Jr 1988
Amer.N. E.Atlantic Europe	Cret.	Strati Taxon.	Foreman H. P. 1977
Amer.N. E.Oregon (Blue-Mts E.Oregon)	Pzc-Mzc	Environ. Biostr.	Blome C. D. *et al.* 1986
Amer.N. E.Oregon W.Idaho.	Tr.-Cret.	Biogeo. Ecolo. Taxon.	Pessagno E. A. Jr & Blome C. D. 1986
Amer.N. E-C.Oregon	Lias.-Dog.	Taxon. Cladist.	MacLeod N. 1988
Amer.N. East-C.Oregon	Tr.-E.Jur.	Taxon.	Yeh K. Y. 1987
Amer.N. East-C.Oregon.	Mzc		Yeh K.-H. 1989
Amer.N. East-C.Oregon.	Tr.		Yeh K.-Y. 1988
Amer.N. Europe E.Atlantic	Cret.	Strati Taxon.	Foreman H.-P. 1977
Amer.N. NW.Nevada	Jur.-Cret.	Ophiol. Strati	Sosson M. *et al.* 1984
Amer.N. Oregon	L.Tr.	Taxon. Strati	Blome C. D. 1983
Amer.N. Oregon British Columbia.	L.Tr.-Jur.	Taxon. Strati	Pessagno E. A. Jr & Blome C. D. 1980
Amer.N. S.Alaska E.Oregon.	Mid.Jur. (Callov.)	Taxon. Strati	Blome C. D. 1984a
Amer.N. SW Oregon Strati	Mzc		Carayon V. *et al.* 1984
Amer.N. SW.Oregon Klamath	Tr.	Strati Ophiol.	Roure F. & De Wever P. 1983
Amer.N. USA Canada	Jur.	Taxon.	Pessagno E. A. Jr *et al.* 1986
Amer.N. W.Calif.	L.Mzc		Seiders V. M. & Blome C. D. 1988
Amer.NW. Amer.N. Calif.	L.Jur.	Strati	Pessagno E. A. Jr *et al.* 1984
Amer.S. Argentina (Neuquén)	Jur.-Cret.	Biostr.	Pujana I. 1988
Amer.S. Feuerland	Cret.		Richter M. 1925
Amer.S. Tripoli (Chile)	Czc Mzc	Taxon. N.Sp. Strati	Frenguelli J. 1941
Asia Austral.		Sedim.	Kobayashi T. 1944
Asia China Himalaya Tibet Gyangze S.Xizang (Tibet)	Cret.		Wu H.-R. & Li H. S. 1982
Asia China Himalaya Tibet Xizang	Cret.		Wu Hao-ruo *et al.* 1977
Asia China Himalaya Tibet Yarlung Zangpo			Wu Hao-ruo 1980
Asia China Japan Sikhote-Alin	Tr.-Jur.		Kojima S. 1989
Asia China S.Tibet	L.Jur.-E.Cret.		Wu H. 1988
Asia China S.Xizang	Tr.-E.Jur.	Taxon.	Yigang W. & Yujing W. 1976
Asia China S.Xizang	Mzc?	Plankton	Wang Yujing & Sheng Jinzhang 1982
Asia China Sea			Tan Zh. & Su X. 1982
Asia China Tibet Himalaya Zangbo Xizang	Cret.	Ophiol.	Wu Hao-ruo & Wanming D. 1980
Asia China Tibet S.Xizang	Cret. Cenom.	Taxon. N.Sp.	Wu H. R. 1986
Asia China Tibet Xizang	Jur. E.Tithon.	Taxon.	Li H. S. 1986
Asia China Tibet Xizang	E.Jur. (L.Pliensb)		Li H. S. 1988

LOCATION	AGE	TOPIC	AUTHOR
Asia China Xish Island		Taxon. N.Sp.	Xinghui S. 1982
Asia China.E		Strati	Zhiyuan T. & Tsorun T. 1976
Asia China.NE.	Tr.-Jur.		Kojima S. & Mizutani S. 1987
Asia China.NE	Tr.-Jur.		Satoru K. & Mizutani S. 1987
Asia ex-USSR Crimea		Ecolo.	Tshedia D. M. 1981
Asia ex-USSR E.Sakhalin	Tr.	Strati	Bragin N. Ju. 1985
Asia ex-USSR NW.Uzbek.	Mzc?		Averburg N. V. & Kestner F. F. 1973
Asia Himalaya Tibet, Ladakh	Mzc Eoc.	Biostr. Strati Ophiol.	Colchen M. *et al.* 1987
Asia India		Ophiol.	Ghosh S. *et al.* 1984
Asia Indones. Borneo Molukken	Jur.-Cret.		Tan Sin-Hok 1927
Asia Indones.		Strati Taxon.	Tan Sin-Hok 1931
Asia Japan		Strati	Ichikawa K. 1946
Asia Japan	Mzc? Pzc? Czc?	Diagen. Silica	Nagata K. 1986
Asia Japan	L.Jur.-Cret.	Taxon. Strati	Nakaseko K. & Nishimura A. 1981
Asia Japan	L.Tr.	Taxon. Strati	Nakaselo K. & Nishimura A. 1980
Asia Japan	L.Jur.	Taxon. Strati	Matsuoka A. 1984a
Asia Japan	Cret.	Taxon. Strati	Nakaseko K. *et al.* 1979a, b
Asia Japan		Sedim. Melange Strati	Nakazawa K. *et al.* 1983b
Asia Japan	Gen.geol.	Strati	Nakaseko K. *et al.* 1983
Asia Japan	L.Tr.-E.Jur.	Biostrl	Igo H. & Nishimura H. 1984
Asia Japan	Jur.	Zonation Strati	Matsuoka A. & Yao A. 1986
Asia Japan	Czc Mzc		Kobayashi T. & Kimura T. 1944a
Asia Japan	Jur.-Cret.	Taxon. N.Sp.	Ichikawa K. & Yao A. 1976
Asia Japan	Mzc	Strati	Ichikawa K. 1986
Asia Japan	Pzc-Czc		Ichikawa K. 1953
Asia Japan	Permo-Tr.	Evolu.	Kobayashi T. & Kimura T. 1944b
Asia Japan	Mzc		Mizutani S. 1987
Asia Japan	Tr.-Jur.		Kido S. 1982
Asia Japan	Mzc Pzc	Gener.	Kimura T. 1944c
Asia Japan	Tr.-Cret.	Sedim. Strati	Matsuoka A. 1983b
Asia Japan	Perm.-Tr.	Strati	Koike T. *et al.* 1974
Asia Japan	Mzc? Czc	Strati	Nakaseko K. 1979b
Asia Japan	Czc	Geol. Strati	Nakaseko K. *et al.* 1979
Asia Japan	Lias.	Strati	Isozaki Y. & Matsuda T. 1985
Asia Japan	Cret.	Strati Correl.	Nakaseko K. 1979
Asia Japan	Jur.	Strati Taxon.	Isozaki Y. *et al.* 1981
Asia Japan	Tr.-Jur.	Taxon.	Yao A. & Ichikawa K. 1969
Asia Japan	Jur.-Cret.	Extinc. Taxon. Strati	Matsuoka A. 1986a
Asia Japan	Jur.	Biostr.	Yao A. 1986
Asia Japan			Sugano K. & Nakaseko K. 1970
Asia Japan	Jur.	Environ.	Sunouchi H. *et al.* 1982
Asia Japan	Tr.-Jur.	Strati Taxon.	Yao A. 1982b
Asia Japan	L.Cret-Czc	Strati	Nakaseko K. *et al.* 1965
Asia Japan			Kimura T. 1944a
Asia Japan	Jur.	Taxon. Strati	Mizutani S. *et al.* 1984
Asia Japan	Jur.-Cret.	Strati	Fujimoto H. 1933b
Asia Japan	Cret.		Murata M. *et al.* 1982
Asia Japan	Carboniferous-Jur.	Strati	Naka T. & Ishiga H. 1987
Asia Japan	Tr.-Jur.	Silica Geoch.	Kakuwa Y. 1987
Asia Japan	Pzc-Mzc	Strati	Koike T. & Takashima K. 1983
Asia Japan		History	Sugano K. 1975
Asia Japan	Mzc		Okimura Y. *et al.* 1986

LOCATION	AGE	TOPIC	AUTHOR
Asia Japan	Jur.	Taxon. Strati	Wakita K. 1982
Asia Japan		Strati	Suzuki J. 1939
Asia Japan	Jur.	Taxon. Evolu.	Takemura A. & Nakaseko K. 1983
Asia Japan	Mzc	Sedim.	Sugano K. 1986
Asia Japan	Tr.	Taxon.	Sato T. *et al.* 1982
Asia Japan		Strati Plankton	Takemura A. 1980
Asia Japan	Jur.		Sashida K. *et al.* 1982a
Asia Japan	E.Jur.		Sashida K. *et al.* 1986
Asia Japan	Tr.-Jur.	Taxon.	Sato T. & Nishizono Y. 1983
Asia Japan	L.Cret.	Geol.	Kurimoto C. 1982
Asia Japan			Sugano K. & Nakaseko K. 1968
Asia Japan	Jur.	Taxon.	Takemura A. & Nakaseko K. 1982b
Asia Japan	Jur.	Taxon.	Takemura A. & Nakaseko K. 1982a
Asia Japan	Jur.	Strati	Matsuoka A. 1985a
Asia Japan	M.Jur.		Yokota S. & Sano H. 1986
Asia Japan	Tr.		Takashima K. & Koike T. 1982
Asia Japan	Jur.	Taxon.	Takemura A. & Nakaseko K. 1982c
Asia Japan	Jur.	Taxon. Strati	Matsuoka A. 1986c
Asia Japan	Mzc Czc	Strati Gen.geol.	Takeshita T. 1982
Asia Japan		Taxon. Skelet. Evolu.	Takemura A. & Nakaseko K. 1986
Asia Japan (Shikoku) Tethys Italy	Mid.Jur.-Earl.Cret.	Biostr. Strati	Aita Y. 1987
Asia Japan Boso Chiba	Czc? Mzc?		Kanomata N. & Iwashita F. 1964
Asia Japan Chichibu		Taxon. Strati	Fujimoto H. 1939
Asia Japan Chichibu	Mesozoic	Strati	Matsuoka A. 1986b
Asia Japan Chichibu	Pzc-Mzc	Gen.geol.	Owada K. & Saka Y. 1982
Asia Japan Chichibu Kyushu	Tr.-Jur.	Biostr.	Sato T. *et al.* 1986
Asia Japan E.Hokkaido	Cret.		Kiminami K. *et al.* 1983
Asia Japan E.Shikoku	Mzc	Strati	Ishida K. 1986a, b
Asia Japan Gifu	Tr. Jur.		Wakita K. & Isomi H. 1986
Asia Japan Hidaka	L.Cret.		Iwata K. & Kato Y. 1986
Asia Japan Hokkaido		Strati	Nagata K. 1982
Asia Japan Hokkaido	Jur.-E.Cret.	Strati	Ishizuka H. *et al.* 1984
Asia Japan Hokkaido	Cret	Strati Gen.geol.	Taketani Y. 1982
Asia Japan Hokkaido	E.Cret.	Strati	Minoura N. *et al.* 1982
Asia Japan Hokkaido	Aptian		Okada H. *et al.* 1982
Asia Japan Hokkaido	Cret.-Czc (Mioc.-Quater.)	Strati	Nagata K. 1979
Asia Japan Hokkaid	Cret.		Tajika J. & Iwata K. 1983
Asia Japan Japan.C.	L.Cret.		Iyota N. *et al.* 1984
Asia Japan Kochi	Jur.	Biostr. Strati	Aita Y. 1982
Asia Japan Kyushu	Mzc		Nishizono Y. *et al.* 1982
Asia Japan Kyushu	Mzc	Sedim.	Nishizono Y. & Murata M. 1983
Asia Japan Kyushu	L.Jur.		Tanaka H. *et al.* 1985
Asia Japan N.Hokkaido	E.Cret.	Strati	Igo H. *et al.* 1987
Asia Japan N.Shimanto	Cret.		Okamura M. 1981
Asia Japan N.Shimanto	L.Cret.		Yamauchi M. 1982
Asia Japan N.Shimanto Shikoku	L.Jur.-Earl.Cret.	Strati	Aoki T. 1982
Asia Japan Okinawa	Cret.	Taxon.	Fujita H. 1983
Asia Japan Okinawa			Ujiie H. & Hashimoto Y. 1983
Asia Japan S.Shikoku		Sedim. Gen.geol.	Yehara S. 1926
Asia Japan Sakawa Tosa			Kimura T. 1944b
Asia Japan Sambagawa	Jur.		Kobayashi T. 1941

LOCATION	AGE	TOPIC	AUTHOR
Asia Japan SE.Kanto	Czc? Mzc	Taxon. Strati	Ichikawa K. 1950
Asia Japan Shikoku	Mzc		Nakagawa C. & Nakaseko K. 1977
Asia Japan Shikoku	L.Jur.-Cret.	Strati	Nakagawa C. *et al.* 1980
Asia Japan Shikoku	Jur.	Biostr. Strati	Aita Y. 1985
Asia Japan Shikoku			Suyari K. & Kuwano Y. 1986
Asia Japan Shikoku	Jur.	Taxon. Strati	Matsuoka A. 1982a
Asia Japan Shikoku	Tr.-Jur.	Taxon.	Yehara S. 1927
Asia Japan Shikoku	Tr.-Jur.	Strati Sedim.	Ishida K. 1985
Asia Japan Shikoku	E.Cret.		Okamura M. & Uto H. 1982
Asia Japan Shikoku	Cret.		Okamura M. & Matsugi H. 1986
Asia Japan Shikoku	L.Cret.		Okamura M. *et al.* 1982
Asia Japan Shimanto	Cret.	Strati	Aoki T. & Tashiro M. 1982
Asia Japan Shimanto	Mzc		Suyari K. 1986a,b
Asia Japan Shimanto Shikoku	Mzc	Strati	Suyari K. & Yamasaki T. 1988
Asia Japan SW.Hokkaido	Jur.	Tecton.	Ishiga H. & Ishiyama D. 1987
Asia Japan Tethys	L.Jur.-Earl.Cret.		Aita Y. & Okada H. 1986
Asia Japan, Tethys Europe ex-USSR Amer.N. Calif.	Mzc	Bioz.	Vishnevskaya V. S. 1985
Asia Japan W.Shikoku. Chichibu	Jur.		Kashima N. 1986
Asia Japan.C.	Jur.	Taxon. Strati	Mizutani S. & Kido S. 1983
Asia Japan.C.	Tr.	Radt Sedim.	Sugisaki R. *et al.* 1982
Asia Japan.C.	E.Cret.		Wakita K. 1988
Asia Japan.C.			Otsuka T. 1986
Asia Japan.C.	Tr.-Jur.	Taxon.	Yao A. *et al.* 1980
Asia Japan.C.	E.Jur.	Taxon.	Sashida K. 1988
Asia Japan.C.	L.Tr.-Earl.Jur.	Biostr.	Yoshida H. 1986
Asia Japan.C.	M.Jur.	Biozon. Biostr.	Matsuoka A. 1988
Asia Japan.C.	Jur.	Taxon. Strati	Mizutani S. *et al.* 1982a
Asia Japan.C. (Mino terr.)	Jur. Mzc	Strati	Adachi M. 1982
Asia Japan.C. Fukui	Jur.		Hattori I. 1987
Asia Japan.C. Fukui	Lias.-Dog.		Hattori I. 1988
Asia Japan.C. Gifu	Mzc	Sedim.	Wakita K. & Okamura Y. 1982
Asia Japan.C. Inuyama	Lias.	Taxon.	Hori R. & Yao A. 1988
Asia Japan.C. Inuyama	Earl.Jur.		Hori R. 1986
Asia Japan.C. Kanto	Cret.		Hisada K.-I. *et al.* 1986
Asia Japan.C. Kanto	Jur.-Cret.		Hisada K.-I & Kishida Y. 1986
Asia Japan.C. Mino	Mzc	Genesis Silica Radt Environ.	Hattori I. 1984
Asia Japan.C. Sambagawa		Sedim. Diagen.	Huzimoto H. 1938
Asia Japan.C.	Perm.-Jur.		Kojima S. 1982
Asia Japan.C.	Tr.	Taxon. Strati	Mizutani S. *et al.* 1981b
Asia Japan.C.	L.Tr.-E.Jur.	Strati	Kishida Y. & Hisada K. 1985
Asia Japan.C.	M.Tr.-E.Jur.	Taxon.	Yao A. 1982a
Asia Japan.C.	Jur.	Sedim. Radt	Wakita K. 1983
Asia Japan.C.	L.Jur.-Cret.	Strati	Yamamoto H. 1983
Asia Japan.C.	Jur.	Gen.geol.	Wakita K. 1983
Asia Japan.C.		Strati	Kishida Y. & Hisada K. 1986
Asia Japan.C.	Jur.	Strati	Mizutani S. *et al.* 1981a
Asia Japan.C.	Cret.	Taxon.	Sashida K. *et al.* 1984
Asia Japan.C.	Mzc	Sedim. Taxon.	Yoshimura M. *et al.* 1982
Asia Japan.C.	Tr.-Jur.	Taxon.	Yao A. 1972
Asia Japan.C.	Tr.-Jur.	Taxon.	Yao A. 1979
Asia Japan.C.	E.Tr.	Taxon.	Sashida K. 1983

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Asia Japan.C.	Tr.-Jur.	Taxon. Strati	Mizutani S. & Koike T. 1982
Asia Japan.C.	Cret.	Taxon. Strati	Iwasaki T. *et al.* 1984
Asia Japan.C.		Strati	Kido S. *et al.* 1982
Asia Japan.C.	Jur.	Strati	Mizutani S. 1981
Asia Japan.C.	L.Tr.-Mid.Jur.	Strati Tecto.	Hattori I. & Yoshimura M. 1983
Asia Japan.N. Hokkaido	L.Jur.-E.Cret.	Taxon. N.Sp.	Kawabata K. 1988
Asia Japan.N. Hokkaido	L.Jur.	Ophiol.	Ishizuka H. *et al.* 1983
Asia Japan.N. Hokkaido	E.Cret.		Kanie Y. *et al.* 1981
Asia Japan.N. NE.Hokkaido	Jur.-Cret.		Iwata K. *et al.* 1983a,b
Asia Japan.NE.	Mzc		Matsuoka A. 1987
Asia Japan.SW.	Perm.-Tr.		Ishiga H. & Kusu T. 1986
Asia Japan.SW.	Tr.-Jur.	Taxon.	Yao A. *et al.* 1982
Asia Japan.SW.	Jur.		Saka Y. 1983
Asia Japan.SW.	Tr.-Jur.	Taxon.	Yao A. 1983
Asia Japan.SW.	Mesozoic	Strati	Nakaseko K. 1981
Asia Japan.SW.	L.Jur.	Taxon. Strati	Matsuoka A. & Yao A. 1985
Asia Japan.SW.	Jur.	Strati	Matsuoka A. 1984b
Asia Japan.SW.	L.Tr.-Earl.Jur.	Biostr	Hori R. 1988
Asia Japan.SW.	Jur.(Dog.)	Strati	Imoto N. *et al.* 1982
Asia Japan.SW.	Tr.-Jur.	Taxon.	Yao A. 1981
Asia Japan.SW.		Strati	Ichikawa K. *et al.* 1985
Asia Japan.SW.	Perm.	Envir.	Imoto N. 1984a
Asia Japan.SW.	Mzc	Envir. Radt	Imoto N. 1984b
Asia Japan.SW.	M.Jur.	Taxon. Strati	Matsuoka A. 1985b
Asia Japan.SW.	L.Tr.	Taxon. N.Sp.	Nakaseko K. & Nishimura A. 1979
Asia Japan.SW.	Tr.-Jur.	Strati	Kishida Y. & Sugano K. 1982
Asia Japan.SW.	Permian		Isozaki Y. 1986
Asia Japan.SW.	Tr.	Taxon. Strati	Isozaki Y. & Matsuda T. 1980
Asia Japan.SW.	Tr.-Jur.	Strati	Matsuda T. & Isozaki Y. 1982
Asia Japan.SW.	Mid.L.Jur.	Taxon. Strati	Matsuoka A. 1982b
Asia Japan.SW.	Jur.	Strati	Hayasaka Y. *et al.* 1983
Asia Japan.SW.	Cret.	Envir.	Nakazawa K. *et al.* 1983a
Asia Japan.SW.	Mzc	Strati	Kamon M. & Taketomi H. 1982
Asia Japan.SW. E.Shikoku		Gen.geol.	Yanai S. 1983
Asia Japan.SW. Kii	Cret.	Taxon. Strati	Matsuyama H. *et al.* 1982
Asia Japan.SW. Shikoku	L.Jur.	Taxon. Strati	Matsuoka A. 1986d
Asia Japan.SW. Shikoku	M.L.Jur.	Strati	Matsuoka A. 1983a
Asia Japan.SW. Shikoku Awaji	Czc Mzc		Yamasaki T. 1987
Asia Japan.SW. Shikoku	Tr.-Jur.	Strati	Ishida K. 1983
Asia Pacif. Indones. C.Celebes	Mzc		Hinde G. J. 1917
Atlant.		Taxon. DSDP	Riedel W.-R. 1971a
Atlant.	Cret.	Biostr.	Cita M. B. *et al.* 1970
Atlant.	M.Cret.	Sedim. Gen.geol. Strati	Schaaf A. 1985
Atlant.	Czc Mzc	Taxon.	Ehrenberg C. G. 1854
Atlant. Carib. (Bahamas)	Mid.Jur.-Earl.Cret.	Strati	Baumgartner P. O. 1983
Atlant. Carib. (La Desirade, Les Antilles)	Earl.Cret.		Bouysse P. *et al.* 1983
Atlant. Europe			Swain F. M. 1977
Atlant. Europe N.Sea.	L.Jur.-E.Cret.	Review Biostr.	Dyer R. & Copestake P. 1989
Atlant.C. Carib. Barbados	Mzc		Ehrenberg C. G. 1846
Atlant.NE. (off Africa)	Cret.	DSDP41	Foreman H. P. 1978b
Atlant.SE.	Cret.	DSDP40 Taxon. Strati	Foreman H. P. 1978a
Atlantic NE.Mediter.	Cret.Quatern.	DSDP13 Taxon. Strati	Dumitrica P. 1973

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Atlantic E. Europe Amer.N.	Cret.	Strati Taxon.	Foreman H. P. 1977
Austral. Indones. New Guinea		Strati	Crespin I. 1958
Canada (Queen-Charl.) Calif. E-C.Oregon	Lias. Dog.	Taxon.	Pessagno E. A. Jr & Whalen P. A. 1982
DSDP16	Mzc-Czc	Strati	Dinkelman M. G. 1973
Europe Amer.N. E.Atlantic	Cret.	Strati Taxon.	Foreman H. P. 1977
Europe C. Poland	Cret.	Morphol.	Gorka H. 1988
Europe E.Atlantic Amer.N.	Cret.	Strati Taxon.	Foreman H. P. 1977
Europe England (Kimmeridge)	Jur. (Kimm.)	Boreal	Downie C. 1956
Europe France (Ardèche)	Late Tithon.	Taxon.	Cayeux L. 1896
Europe France (Larzac)	Mzc		Bergounioux F. M. 1950
Europe France (Paris Basin.) Belgium	Mzc	Chalk Sedim.	Cayeux L. 1897
Europe Italy Sicily	M.Jur.		Kito *et al.* 1990
Europe	Mzc	Taxon. Evolu. Strat. Techn.	De Wever P., Riedel W. *et al.* 1979b
Europe N.France	Jur. (Oxf.), Eoc.		Cayeux L. 1891
Europe N.Germany	Cret.	Taxon.	Zittel K. A. 1876
Europe Poland Krakau	L.Jur.		Wisniowski T. 1889
Europe Slovak. Czcek. (Meliata, Silica, Slovak Karst)	Tr.-Jur.	Ophiol. Radt	Dumitrica P. & Mello J. 1982
Europe Turkey	Lias.	Taxon.	Pessagno E. A. Jr & Poisson A. 1981
ex-USSR	Mzc Czc?	Strati	Zhamoida A. I. 1975
ex-USSR	Mesozoic	Strati	Zhamoida A. I. 1972
ex-USSR	Pzc Mzc	Taxon.	Afanasieva M. S. 1986
ex-USSR	Mzc	Strati	Zhamoida A. I. 1981
ex-USSR	Mesozoic	Strati	Zhamoida A. I. 1961
ex-USSR	Mzc		Zhamoida A. I. & Kazintsova L. 1981
ex-USSR	Cret.	Biostr.	Kazintsova L. & Vishnevskaya V. 1988
ex-USSR	Cret.	Strati	Rundyova N. P. & Jinoridze N. 1975
ex-USSR	Cret.?	Taxon. N.Sp. Strati	Vishnevskaya V. S. 1985a
ex-USSR	Cret.	Taxon. Strati	Vishnevskaya V. S. 1981b
ex-USSR	Cret. Cenom.		Kazintsova L. I. 1981
ex-USSR	Mzc	Taxon. Skelet.	Vishnevskaya V. S. 1981c
ex-USSR Amer.N. Calif, Asia Japan, Tethys Europe	Mzc	Bioz.	Vishnevskaya V. S. 1985
ex-USSR Carpath. Ukrain.	Jur.	Strati	Lozynyak P. Yu. 1981
ex-USSR Carpath. Ukrain.	Cret.		Lozynyak P. Yu. 1975
ex-USSR E.-Sakhalin	Mzc	Strati	Zhamoida A. I. 1968
ex-USSR E.Sakhalin	L.Cret.		Kazintsova L. 1985
ex-USSR E.Siber. Sikhote-Alinj	Mzc		Eliseeva V. K. *et al.* 1976
ex-USSR Far East	Cret.	Taxon. Strati	Vishnevskaya V. S. 1981a
ex-USSR Greater & Lesser Caucasus	L.Jur.-Cret.	Biostr.	Vishnevskaya V. S. 1988a-c
ex-USSR Kamchatka			Runeva N. P. 1975
ex-USSR Kamchatka Asia			Vishnevskaya V. S. & Bernard V. V. 1986
ex-USSR Kazakhstan	Czc? Mzc?	Strati	Pupyshev N. A. & Lipman R. 1973
ex-USSR Koriak	Mzc	Strati	Bogdanov N. A. *et al.* 1982
ex-USSR Koryak	Mzc	Strati	Vishnevskaya V. S. *et al.* 1981
ex-USSR Koryaksk	Valanginian	Strati	Dundo O. P. & Zhamoida A. I. 1963
ex-USSR Lesser Caucasus	Mzc	Strati	Zhamoida A. I. *et al.* 1976
ex-USSR Mid.Asia	Mzc		Tshedia D. M. 1984
ex-USSR N.Pacif. Bering Polar	M.L.Cret.	Biozon. Strati Environ.	Vishnevskaya V. S. 1986
ex-USSR Olutor	Cret.-Czc	Strati	Vishnevskaya V. S. 1984a, b
ex-USSR Olyutor Koryak	Cret.		Vishnevskaya V. S. 1987a, b

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ex-USSR Russia	Pzc-Mzc	Gener.	Lipman R. Kh. 1976
ex-USSR Russia	Mzc	Evolu. Taxon.	Lipman R. Kh. 1975b
ex-USSR Russia	Jur.-Cret.	Strati	Lipman R. Kh. 1979b
ex-USSR Russia	Paleogene-L.Cret.	Strati	Lipman R. Kh. 1975a
ex-USSR Russia	L.Cret.	Taxon.	Lipman R. Kh. 1952
ex-USSR Russia Far East	Mzc		Lipman R. Kh. 1953
ex-USSR Russia W.Siberian Turgaisk N.Peri-Aral	L.Cret.		Lipman R. Kh. 1962
ex-USSR Sakalina Kamtchatka	Mzc?		Runeva N. P. 1981
ex-USSR Sakhalin	Mesozoic	Strati	Zhamoida A. I. 1969
ex-USSR Siber. Russia	Czc Mzc		Lipman R. Kh. 1960
ex-USSR Sikhote	Mesozoic	Strati	Zhamoida A. I. 1968
ex-USSR Sikhote-Alin.	Mzc		Tikhomirova L. B. 1975
ex-USSR Tadzhik	Cret. Campan.	Taxon. N.Sp.	Goltman E. V. 1984
ex-USSR Tadzhik	Cret. Senon.	Evolu.	Goltman E. V. & Babaeva B. 1985
ex-USSR Tadzhiksk	Cret. Senon. Quater.	Strati	Goltman E. V. 1981
ex-USSR Tadzhiksk	Cret. (Campan. Maastr.)		Goltman E. V. 1973
ex-USSR Tadzhiksk		Strati	Goltman E. V. 1975
ex-USSR Tethys Carpath.	Earl.Cret.		Tikhomirova L. B. 1983
ex-USSR Tethys Caucasia	Jur.		Tikhomirova L. B. 1981
ex-USSR Timan-Ural	E.Kimm.		Kozlova G. E. 1971
ex-USSR Ukrain. Carpath.	Cret.		Kazintsova L.I. 1984
ex-USSR Urals	Cret.	Biozon.	Amon E. O. 1988
ex-USSR W.Siberia	L.Cret.-Eocene		Kozlova G. E. & Gorbovets A. 1966
ex-USSR W.Siberia	Cret. Turon.	Strati	Amon E. O. 1985
Indian S.	Cret.		Riedel W. R. & Sanfilippo A. 1974
Mediter.	M.Cret.	Ecology Biostr.	Thurow J. & Kuhnt W. 1988
Mid.East Israel	Earl.Cret.-Czc		Reiss Z. 1952
N.Africa	Turon.	Anoxy	Thurow J. 1988
Pacif Indones.	Czc Mzc	Sedim.	Hinde G. J. 1897
Pacif.	Cret.	Strati Taxon.	Schaaf A. 1984b
Pacif.	Cret.	Strati Envir. Taxon.	Schaaf A. 1984a
Pacif.		Strati DSDP	Riedel W. R. 1981
Pacif. Amer.C.		Strati	White M. P. 1928
Pacif. Austral.	Pzc-Mzc	Tecton.	Flood P. G. 1988
Pacif. Austral.	Mzc	Sedim. Envir.	Fenton M. W. *et al.* 1982
Pacif. Australia	Czc? Mzc? Pzc?	Sedim.	Hinde G. J . 1893
Pacif. Indones. Borneo	Cret.		Hinde G. J. 1900
Pacif. Indones. Borneo	Tr.	Taxon.	Hinde G. J. 1908
Pacif. Indones. Celebes	Mzc?		Hojnos R. 1934
Pacif. Mariana Leg 60	Cret.	Strati DSDP	Kling S. A. 1982
Pacif. New Zealand	L.Tr.		Blome C. D. *et al.* 1987
Pacif. New Zealand	Jur.		Feary D. A. & Hill P. H. 1978
Pacif. New Zealand	Jur.-Cret.	Strati	Feary D. A. & Pessagno E. A. Jr 1980
Pacif.N.	Cret.	Strati Taxon. DSDP32	Foreman H. P. 1975
Pacif.SW.		Plankton Geograph.	Stevens G. R. 1980
Pacific Mid.	Cret. Campan.	Taxon. DSDP	Empson-Morin K. M. 1981
Tethys	Tr.-Cret.	Taxon. Evolu.	De Wever P. 1984b
Tethys	Jur.-Cret.	Taxon.	Fischli H. 1916
Tethys	Mid.Jur.-Earl.Cret.	Strati Taxon	Baumgartner P. O. 1984

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Tethys	Mzc-Czc	Taxon. Evolu.	Dumitrica P. 1983a
Tethys	Jur.	Environ. Sedim. Biostr	Baumgartner P. O. 1987
Tethys	Mid.-Tr.	Taxon. Evolu.	Dumitrica P. 1983b
Tethys	Tr.-Jur.	Taxon. N.Sp.	Kozur H. 1984b
Tethys	Tr.-Jur.	N.Sp. Taxon.	Kozur H. 1984d
Tethys	Mid.Tr.	Taxon. N.Sp.	Dumitrica P. 1982b
Tethys	Tr.	Taxon. N.Sp.	Dumitrica P. 1982a
Tethys		Diagen. Sedim. Silica	Hattori I. 1989
Tethys			Kito N. & De Wever P. 1988
Tethys	Tr.-Cret.	Taxon. Evolu. Phylogen.	De Wever P. & Origlia I. 1984
Tethys	Tr.-Cret.	Taxon. Evolu. Phylogen.	De Wever P. & Origlia I. 1983
Tethys Alpes France Ligurian	Jur.	Strati Ophiol.	De Wever P. & Caby R. 1981
Tethys Alps Austria	Jur.	Taxon. Strati	Muzavor S. N. X. 1977
Tethys Alps Austria N.Kalkalpen	L.Jur-E.Cret.	Taxon. Strati	Holzer H.-L. 1980
Tethys Alps Europe	Mzc	Taxon.	Donofrio D. A. & Mostler H. 1978
Tethys Alps Italy	Jur.-Cret.	Strati Taxon. Radt	Kocher R. N. 1981
Tethys Alps N.Italy (Recoaro) Austria	L.Tr.	Taxon. N.Sp.	Lahm B. 1984
Tethys Alps NW.Carpath. Klippen Z.	Mzc		Hojnos R. 1929
Tethys Amer.C.	Jur.-Cret.	Radt	De Wever P. *et al.* 1986a
Tethys Budva (Montenegro, Yugoslavia)	Jur.-Cret.	Taxon.	Gorican S. 1987
Tethys Bulgaria Trekljano S.W.Bulgaria			Zagorcev I. & Tikhomirova L. 1986
Tethys Carpath.	L.Jur.	Biostr.	Ozvoldova L. & Petercakova M. 1987
Tethys Carpath. Klippen	Jur.		Ozvoldova L. & Sykora M. 1984
Tethys Carpath. Klippen	L.Jur.		Ozvoldova L. 1975
Tethys Carpath. Klippen	L.Jur.		Ozvoldova L. 1979a
Tethys Carpath. Mediter. Lesser Caucas.	L.Jur.-Cret.		Tikhomirova L. B. 1984
Tethys Carpath. Slovak. Klippen Podbiel	Jur.		Ozvoldova L. 1979b
Tethys Cret.	Jur.	Taxon. Evolu.	De Wever P. 1983
Tethys Cyprus Oman	Jur.-Cret.	Strati	Blome C. D. & Irwin W. P. 1985
Tethys Cyprus. (Troodos)	Cret.-Czc	Strati Envir. Ophiol.	Robertson A. H. & Hudson J. D. 1974
Tethys E.Carpathians S.Alps	Tr.	Taxon. N.Sp. Phylogen.	Dumitrica P. 1982c
Tethys E.Rhodope Bulgaria	E.Cret.	Strati	Lipman R. Kh. & Boyanov I. 1976
Tethys Europe	Cret.		Rüst D. 1887
Tethys Europe	Cret.	Taxon.	Rüst D. 1888
Tethys Europe	Tr.(Ladin.)	Taxon. N.Fam.	Kozur H. 1988
Tethys Europe	Tr.	Taxon.	Kozur H. & Mostler H. 1984
Tethys Europe	Jur.-Cret.	Taxon.	Rüst D. 1898
Tethys Europe	Jur.	Taxon.	Rüst D. 1885
Tethys Europe	Tr.	Taxon.	Rüst D. 1892
Tethys Europe (Italy, Spain, France) Amer.N. Calif.	Pzc-Czc	Skelet.	De Wever P. 1985
Tethys Europe Alps	Tr.	Taxon. N.Sp.	Kozur H. & Mostler H. 1981
Tethys Europe Alps	Oxf.-Kimm.	Strati Envir Taxon. Ophiol.	Schaaf A. *et al.* 1985
Tethys Europe Alps	Tr.-Jur.	Taxon. N.Sp.	Kozur H. & Mostler H. 1979a
Tethys Europe Alps	Tr.	Taxon. N.Sp.	Kozur H. & Mostler H. 1972
Tethys Europe Alps	Tr.-Jur.	Taxon.S N.Sp.	Kozur H. & Mostler H. 1978
Tethys Europe Alps Austria	Tr.	Taxon. N.Sp.	Kozur H. & Mostler H. 1979b
Tethys Europe Alps Austria Kalkalpen Salzburg	L.Jur.	Sedim.	Steiger T. 1981
Tethys Europe Austria Salzburg	Earl.Lias.		Dunikowski E. V. 1882
Tethys Europe Carpath. Meliata-Serie	Pzc-Mzc	Strati	Kozur H. & Mock R 1973
Tethys Europe Corsica	Jur.-Cret.	Ophiol. Strati	De Wever P. *et al.* 1987b

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Tethys Europe Eastern Rhodops Bulgaria	Earl.Cret.		Boyanov I. & Lipman R. Kh. 1973
Tethys Europe ex-USSR Amer.N. Calif, Asia Japan	Mzc	Bioz.	Vishnevskaya V. S. 1985
Tethys Europe Greece	Tr.-Jur.	Strati Envir. Paleogeog.	De Wever P. & Dercourt J. 1985
Tethys Europe Greece Crete	Tr.	Metam. Strati	Kozur H. & Krahl J. 1984
Tethys Europe Greece Ionian	Callov.-Tithon.		Karakitsios V. *et al.* 1988
Tethys Europe Greece Italy Sicily Turkey	Tr. Lias.	Taxon. Strati	De Wever P. 1982b
Tethys Europe Greece Pindos	Jur.-Cret.	Strati	De Wever P. & Origlia I. 1982a
Tethys Europe Greece Pindos	Lias.	Taxon. Radt	De Wever P. & Origlia I. 1982b
Tethys Europe Greece Pindos-Olonos	Dogg.-Malm.	Strati	De Wever P. & Cordey F. 1984
Tethys Europe Greece Pindos-Olonos	Jur.-Cret.	Taxon. Environ.	De Wever P. & Thiébault F. 1981
Tethys Europe Greece Pindos-Olonos	L.Tr.		Zagorcev I. *et al.* 1989
Tethys Europe Hungary	Mzc		Hojnos R. 1916
Tethys Europe Hungary Mechek	L.Jur.	Sedim. Strati	Nadj I. 1971
Tethys Europe Italy (Euganei)	Cret.	Taxon.	Squinabol S. 1903
Tethys Europe Italy (Euganei)	Cret.	Taxon.	Squinabol S. 1904
Tethys Europe Italy (Lagonegro)	Tr.-Cret.		De Wever P. & Miconnet P. 1985
Tethys Europe Italy (Ligur., Apenn.Mt.Alpe)	Jur.	dating	Conti M. *et al.* 1988
Tethys Europe Italy (Veneto)	Cret.	Taxon.	Squinabol S. 1914
Tethys Europe Italy Alpes	Jur.	Ophiol.	De Wever P. *et al.* 1987
Tethys Europe Italy Alps Monginervo	Cret.	Taxon.	Squinabol S. 1912
Tethys Europe Italy Bolognese	Mzc	Taxon.	Neviani A. 1900
Tethys Europe N.Apen. Italy (La Spezia)	Tr./Lias.	Taxon. Strati	Ciarapica G. & Zaninetti L. 1982
Tethys Europe N.Hungary	Jur.(Bajoc.)	Taxon.	Kozur H. 1985
Tethys Europe N.Hungary	Jur.	Taxon.	Kozur H. & Mostler H. 1986
Tethys Europe N.Hungary Rudabanya	Mid.Jur.		Grill H.-J. & Kozur H. 1986
Tethys Europe NW.Yugoslavia	Mid.Tr.	Taxon. Biostr.	Gorican S. 1988
Tethys Europe Romania	Jur.-Cret.	Taxon.	Dumitrica P. 1970
Tethys Europe Russia Urals	E.Perm.	Taxon.	Kozur H. & Mostler H. 1989
Tethys Europe Slovenia (NW Yugosl.)	Ladin.(M.Tr.)	Taxon.	Kolar-Jurkovsek T. 1989
Tethys Europe Slovenia	Tr.-Jur.		Gorican S. & Kolar-Jurkovsek T. 1984
Tethys, Europe Spain, Sicily, SE France	L.Jur.- E.Cret.	Biostr.	Manivit H. *et al.* 1986
Tethys Europe Switzer.	Mzc Czc	Taxon.	Jaccard F. 1909
Tethys Europe	Taxon.	N.Sp., Evolu.	Kozur H. & Mostler H. 1983
Tethys Europe Turkey	Lias.	Taxon.	De Wever P. 1984c
Tethys Europe Turkey	Lias.	Taxon. N.Sp.	De Wever P. 1982a
Tethys Eur. W. Carpath. Kysuca Klippen	Mzc	Biostr	Ozvoldova L. 1988
Tethys Europe W.Carpath.	Mzc Jur.		Kozur H. & Mock R. 1985
Tethys Europe W.Carpaths Meliata	Jur.		Kozur H. & Mock R. 1985
Tethys France Htes-Alpes	L.Jur.-E.Cret.		Turner J. 1965
Tethys German	Dog.		Heitzer I. 1930
Tethys Greece	Late Jur.	Taxon. Strati	Baumgartner P. O. 1980
Tethys Greece	Jur.-Cret.	Radt	Thiébault F. *et al.* 1980
Tethys Greece (Evvoia, E.Greece)	Late Jur.-Earl.Cret.	Strati Taxon.	Baumgartner P. O. & Bernoulli D. 1976
Tethys Greece (Peloponnesus)	Jur.	Strati Sedim.	Baumgartner P. O. 1985
Tethys Greece Argolis	Jur.-Cret.		Baumgartner P. O. 1981
Tethys Greece Epireous	Jur.	Taxon. Strat.	Danelian T. 1989
Tethys Greece Epireous	Jur.-Cret.	Strati	Danelian T. *et al.* 1986
Tethys Greece Europe Asia Amer.	Jur.-Cret.	Radt Climat	De Wever P. 1987
Tethys Greece Hungary	Mid.Jur.-Cret.	Taxon.	Cordey F. 1984
Tethys Greece Italy	L.Jur.-Earl.Cret.	Strati	Baumgartner P. O. 1980

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Tethys, Greece, Italy Amer.C. Costa Rica	L.Jur.-Earl.Cret.	DSDP	Devos I. 1983
Tethys Greece Italy (Sicily) Amer.C. Costa Rica Indian	Jur.-Cret.	DSDP Taxon. Strati	Origlia-Devos I. 1983
Tethys Greece Italy Lombardia	Jur.-Cret.	N.Sp. Taxon.	De Wever P. 1981c
Tethys Greece Mediter. Karpathos	Cret.		Vinassa de Regny P. E. 1901-02
Tethys Greece Pindos Europe	Jur.-Cret. Baj.(?)-. Tithon	Strati Taxon.	De Wever P. & Cordey F. 1986
Tethys Greece PindosZ. (S.Peloponnes.)	Jur.-Cret.		Thiebault F. *et al.* 1986
Tethys Greece Sicily, Turkey.	Tr.	Taxon. N.Sp.	De Wever P. *et al.* 1979a
Tethys Hungary (Darno)	Tr.	Strati	De Wever P. 1984a
Tethys Hungary Bukk	Jur.	Strati Biogeo	Kozur H. 1984e
Tethys Hungary Carpath. Bükk Meliata Uppony Mecsek	Mzc	Strati	Kozur H. 1984a
Tethys Italy	Mzc-Czc	Taxon.	Vinassa de Regny P. E. 1898a
Tethys Italy (Lombardy, Sicily) Japan (Shikoku)	Mid.Jur.-Earl.Cret.	Biostr. Strati	Aita Y. 1987
Tethys Italy (Sicily)	Jur.-Cret.	Taxon. Biostr.	De Wever P. *et al.* 1986b
Tethys Italy (Sicily)	Late.Jur.-Earl.Cret.	Biostrat. Taxon.	De Wever P. *et al.* 1985
Tethys Italy (Spezia)	Tithon.	Taxon.	Vinassa de Regny P.E. 1899
Tethys Italy Alps E.Carpathians (Rom.)	Tr.	Taxon. N.Sp.	Dumitrica P. 1978c
Tethys Italy Appennine	Jur.		Marcucci M. *et al.* 1987
Tethys Italy Bolognese	Jur.		Vinassa de Regny P. E. 1900
Tethys Italy E.Liguria (Mte Alpe)		Taxon.	Conti M. & Passerini M. 1988
Tethys Italy Europe	Mzc Czc	Taxon.	Neviani A. 1901
Tethys Italy Europe C.Appennine	Cret. (Cenom.-Turon.)	Biostr	Marcucci Passerini M. *et al.* 1988
Tethys Italy France Ligury Europe Alps	Jur.-Cret.	Ophiol. Strati	De Wever P. *et al.* 1987a
Tethys Italy N.Apennine Corsica	Jur.-Cret.	Strati	Conti M. *et al.* 1985
Tethys Italy N.Apennines	Jur.	Stratig. ophiol.	Barret T. J. 1982
Tethys Italy N.Apennines	Jur.-Cret.	Strati	Conti M. & Marcucci M. 1986
Tethys Italy S.Tuscany		Biostr.	Conti M. 1986
Tethys Italy Spezia	Jur. Tithon.		Vinassa de Regny P. E. 1898b
Tethys Morocco (Rif)	Jur.-Cret.	Paleogeog. Strati Envir.	De Wever P. *et al.* 1985b
Tethys Morocco N.Rif	Jur.-Cret.	Taxon. Strati Radt	El-Kadiri Kh. 1984
Tethys NW Greece Ionian	Jur.	Biostr.	Danelian T. & De Wever P. 1988
Tethys Oman	Permian-Cret.	Biostr.	De Wever P. & Bourdillon C. 1988
Tethys Oman	Cret.	Strati Ophiol.	Beurrier M. *et al.* 1987
Tethys Oman	Perm.-Cret.	Radt Tethys strat.	Bourdillon C. *et al.* 1987
Tethys Oman (Hawasina)	Mzc Permian	Strati Paleogeog.	De Wever P. *et al.* 1988
Tethys Oman (Hawasina)		Strati	Blome C. D. *et al.* 1983
Tethys Oman (Samail N.)	Cret.(Senon.)	Radt Taxon. N.Sp.	De Wever P. & Bourdillon C. 1988
Tethys Oman (Semail)	Cret. Campan.	Strati Taxon. Ophiol.	Schaaf A. & Thomas V. 1986
Tethys Oman (Semail)	Jur.-Cret.	Ophiol.	Tippit P. R. *et al.* 1983
Tethys Oman Hawasina	Mzc		Davis A. G. 1950
Tethys Pannonian Hungary	Mzc	Biogeo Strati	Kozur H. 1984c
Tethys Romania	Jur.-Cret.	Radt	Protescu O. 1933
Tethys Romania Carpath.	Cret.(Cenom.)	Taxon. Strati	Dumitrica P. 1975
Tethys Rotti Europe Italy	Mesozoic	Taxon. Strati	Riedel W. R. 1953
Tethys S.Alps.	Mid.Tr.	Taxon. Strati	Dumitrica P. *et al.* 1980
Tethys Tethys Oman Samail	Cret.(Senon.)	Taxon. Ophiol.	De Wever P. *et al.* 1988
Tethys Turkey	Lias.	Taxon. N.Sp.	De Wever P. 1981b

LOCATION	AGE	TOPIC	AUTHOR
Tethys Turkey	Lias.	Taxon. N.Sp.	De Wever P. 1981a
Tethys Turkey	Mzc	Ophiol.	Bailey E. B. & McCallien W. J. 1953
Tethys W.Carpath. Yugosl.	L.Jur.-E.Cret. (Tithon.-Neocom.)	Sedim.	Misik M. 1973
Tethys W.Slovenia	E.Cret.		Pavsic J. & Gorican S. 1987
Tethys Yugosl.	Mzc	Radt	Obradovic J. & Gorican S. 1987
Tethys Yugoslvia Slovenia	Jur.	Taxon.	Gorican S. 1983
W.Pacif.	E.Cret.	DSDP62 Strati Taxon.	Schaaf A. 1981b
W.Pacif. Indones. Borneo	Mzc	Strati Dating Ophiol.	Leong K. M. 1975
W.Pacif. Palawan Block, Philippines	L.Pzc-Earl.Mzc	Strati	Cheng Y.-N. 1989
W.PAcif.E.Australia (New England)	Pzc Mzc		Aitchison J. 1988
W.Pacific, DSDP Leg 61	Czc Mzc Cret.	Strati	De Wever P. 1981d
World	Mzc		Premoli-Silva I. *et al.* 1976