

## UPPER TRIASSIC CONODONTS FROM NORTHEASTERN RUSSIA: PALEOBIOGEOGRAPHY, EVOLUTIONAL STAGES, BIOSTRATIGRAPHY

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A detail biogeographic division of Late Triassic Tethyan and Boreal seas based on conodonts makes troubles for researchers. Firstly, this is due to the fact that the data on the fauna from southern and northern latitudes are understudied. Secondly, there is an ambiguity in treating of lots of genus taxa. Studying the area of the north of Asia in Russia, we have found new occurrences of Upper Triassic conodonts there. This allows us to draw the paleogeographic zoning taking into account the data on Boreal regions.

### Upper Triassic

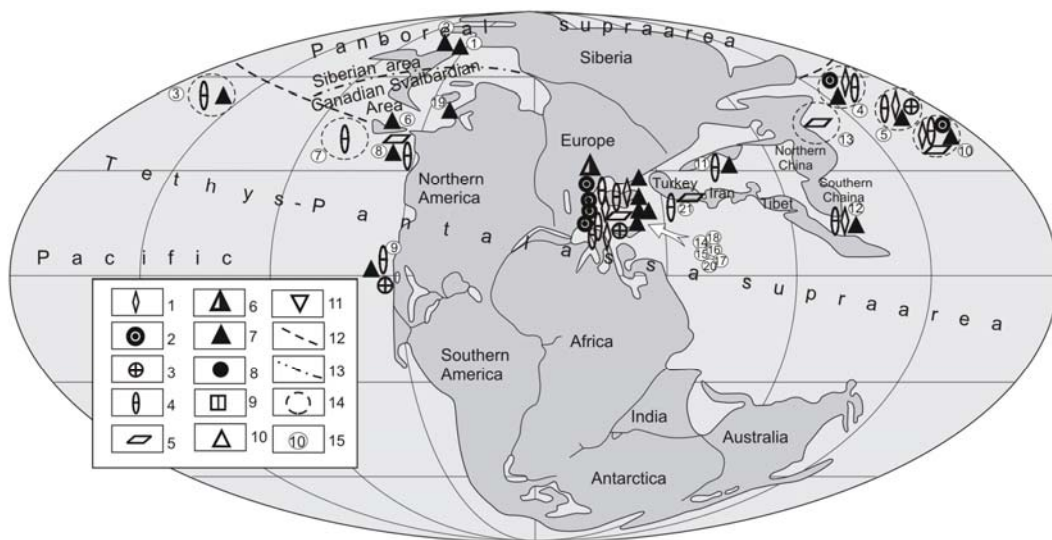


Fig. 1.: Geographic distribution of conodonts in Carnian.

Tethyan genera: 1 – Gladigondolella, 2 – Budurovignathus, 3 – Mosherella, 4 – Epigondolella, 5 – Metapolygnathus, 6 – Pseudofurnishius; cosmopolite genera: 7 – Paragondolella, 8 – Norigondolella, 9 – Mockina, 10 – Parvigondolella, 11 – Misikella; paleobiochores boundaries: 12 – supraarea, 13 – area; 14 – conodonts localities in terranes; 15 – regions; 1 – Kotelny Island; 2 – Zyryanka river; 3 – Koryak uplift; 4 – Middle Sikhote-Alin; 5 – Primoriye; 6 – Northern Alaska; 7 – eastern Alaska; 8 – British Columbia; 9 – South-western USA; 10 – Japan; 11 – South-eastern Pamir (Tajikistan); 12 – Southern China; 13 – Northeastern China; 14 – Austria; 15 – Slovenia; 16 – Hungary; 17 – Yugoslavia; 18 – Slovakia, 19 – Northern Arctic Islands; 20 – Northern Italy; 21 – Turkey.

**Carnian Age.** Together with a decrease of systematic diversity, the conodont associations were renewed at the beginning of the Late Triassic. *Gondolathus* and *Celsigondolella* had become extinct, but *Mosherella* had occurred by this time. *Paragondolella foliate*, *P. inclinata*, *P. tadpole*, *P. polygnathiformis*, and *P. aff. polygnathiformis* dominating in associations had spread in all latitudes. *Epigondolella* and *Metapolygnathus* had appeared at the end of the Carnian.

Carnian conodonts are currently known from British Columbia and Queen Charlotte Islands, south-western USA, northern and eastern Alaska, Northern Arctic Islands, Japan, southern and northeastern China, Tajikistan, Russia (Koryak uplift, Kotelny Island, Zyryanka river, middle Sikhote-Alin), Austria, Slovenia, Hungary, Slovakia, Yugoslavia, northern Italy, Turkey (Fig. 1).

Carnian conodonts are scarce in northern latitudes. Boreal conodont associations differ from the Tethyan ones by a low diversity of the fauna represented only by cosmopolite *Paragondolella*. The differences between Canadian-Svalbardian and Siberian areas become negligible and can be observed only at the level of species. Basically, in the history of conodonts in the Carnian, evolution resulting in taxa change reaches a new peak only in Tethyan regions. In the seas of the northern part of the Tethys, *Pseudofurnishius*, *Mosherella*, *Budurovignathus*, and *Gladigondolella*, together with cosmopolite *Paragondolella*, were characteristic genera at the beginning of the Carnian, but *Epigondolella* and *Metapolygnathus* had widely spread by the end of the Carnian.

**Norian – Rhaetian Ages.** Together with a continuous decrease of taxa diversity in associations, the next stage of evolution took place again at the beginning of the Early Norian. *Epigondolella abneptis*, *E. quadrata*, *E. triangularis*, *E. primitia*, *E. nodosa*, *Mockina postera*, *M. multidentata*, *Norigondolella navicula*, *N. hallstattensis* and *N. steinbergensis* dominated in seas in this time. Genera *Parvigondolella*, *Misikella* and *Mockina bidentata* predominated from the end of the Norian to the Rhaetian.

Norian and Rhaetian conodonts are known from Russia (Kotelny Island, middle Sikhote-Alin, Primoriye), Tajikistan, Japan, British Columbia and Queen Charlotte Islands, south-western USA, northern and eastern Alaska, Austria, Slovenia, Poland, Slovakia, Yugoslavia, Turkey, Australia, Tibet (Fig. 2).

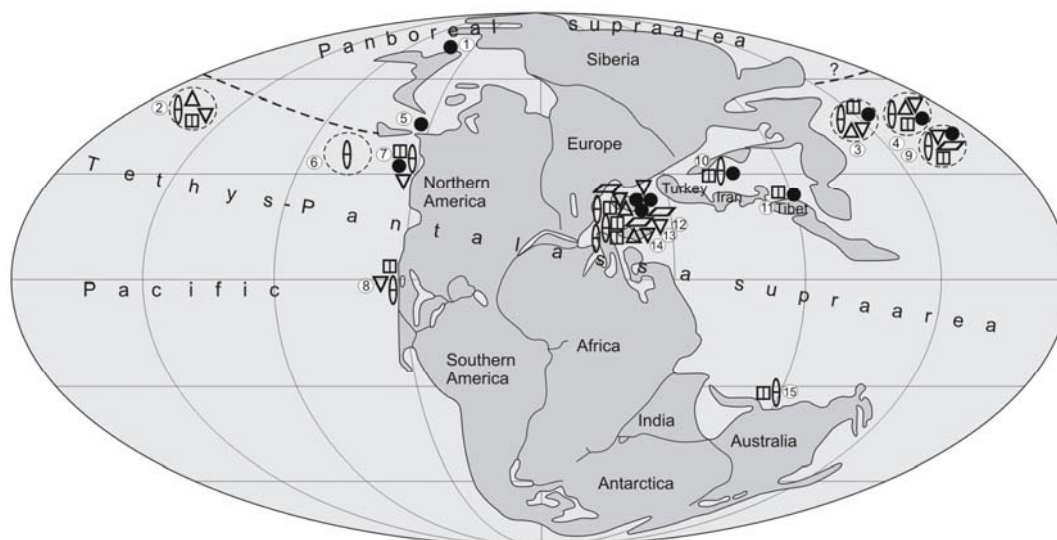


Fig. 2. Geographic distribution of conodonts in Norian and Rhaetian.

Regions: 1 – Kotelny Island; 2 – Koryak uplift; 3 – Middle Sikhote-Alin; 4 – Primoriye; 5 – Northern Alaska; 6 – Eastern Alaska; 7 – British Columbia; 8 – South-western USA; 9 – Japan; 10 – Tajikistan; 11 – Tibet; 12 – Austria, Slovakia; 13 – Slovenia; 14 – Yugoslavia; 15 – Australia; 16 – Turkey; see genera on Fig.1.

Almost all conodont occurrences mentioned above take place in northern Tethyan regions where sculptured *Epigondolella* and *Mockina* dominated. In northern latitudes only cosmopolite genus *Norigondolella* represented by two species inhabited in the Norian. In Boreal regions rare conodonts were found only in Kotelny Island in the *Monotis ochotica* Zone and in Alaska Peninsula in the Shublik formation.

There is no possibility to estimate a differentiation of the conodont fauna within the Panboreal Supraarea for the Norian Age. Rhaethian conodonts in northern latitudes were not established. *Misikella* characterized by very simple morphologic features represented the largest group in the Tethys-Pantalassa supraarea in the Raethian. The northern regions of the supraarea were the only place where they were found.

As study has shown, the evolution of conodonts from northern and southern latitudes paced differently at the final stage of their development that reflects in zone timescales. By example of conodont evolution in the Siberian region (Arctic basin) in the Late Triassic, the stage of development in the Carnian-Norian is divided into two phases. In the northwestern Pacific the stage is divided into Early Carnian and Late Carnian-Norian substages consisting of six phases and Rethian substage (Fig. 3).

Stage	Arctic basin				Northwestern Pacifica			
	<i>Transgression</i> → Kurushin, Zakharov, 1995	Zones, layers, deposits with conodonts	Substages (1) and phases (2) of conodonts development		Global eustatic curve  Haq et., 1987 <i>Transgression</i> →	Zones Russian Far East, Japan  Igo, Koike, 1983; Igo, 1989; Buryi, 1989; Bragin, 1991; Klets, 1995	Substages (1) and phases (2) of conodonts development	
			1	2			1	2
Rhaetian		?	?			Mi. posthernsteini	Rhaetian	
Norian	B	layers with <i>No. steibergensis</i>	Carnian- Norian	2		Mi. hernsteini		6
	C	?				Par. andrusovi		5
	H	layers with <i>No. navicula</i>				M. postera	Late Carnian-	4
Carnian	B	Deposits with <i>Paragondolella</i> sp.		1		E. abneptis	Norian	3
	H	layers with <i>Pa. foliata</i>				E. nodosa		2
Ladinian	B	deposits with conodonts	Ladinian			Pa. polygnathiformis		1
	H	layers with <i>N. balkanica</i>					Pa. foliata	Early Carnian
Anisian	B	layers with <i>N. constricta</i>	Anisian			Bu. mungoensis	Late Ladinian	
	C	Сл. с <i>N. aff. mombergensis</i> - <i>N. aff. constricta</i>				Bu. truempy		4
	H	Слой с <i>Ch. dalganensis</i>				N. mombergensis		
		?				N. constricta- Pa. excelsa	Anisian-	3
						N. bulgarica	Early Ladinian	2
						N. regale		
						Ch. timorensis		1

Fig. 3: The stages of development and surface leveling of conodonts associations in Middle and Late Triassic. 1 – surface leveling.

The increase of paleotemperature of the sea water and gigantic rise of the World Ocean at the beginning of the Late Triassic and beginning of the Norian (HAG et al., 1987; KURUSHIN, ZAKHAROV, 1995) conduced to the taxonomic change of conodont associations in southern seas & synchronic invasion of taxa in northern seas (Fig. 3).

### Conclusion

1. The main principle of geographic differentiation of Triassic conodonts was climatic zonation.
2. **Tethys-Pantalassa supraarea** characterized by the largest taxonomic diversity seems to be in the tropic belt or nearby, since this place was the most propitious for the development of marine faunas. The fact that southern Tethyan conodont associations are scarce indicates that the water of this part of the Tethys was relatively cool.
3. **Panboreal supraarea** comprising the basins only of northern latitudes is represented by less taxonomic diversity and it is characterized by cosmopolite long-living, mainly, smooth unsculptured genera. Boreal associations are peculiarly scarce in the Late Carnian and

Norian Ages. In the Rhaetian in the northern seas conodonts seemed to be absent. In the Carnian, **Siberian area** comprising Northeastern Asia and **Canadian-Svalbardian area** including archipelago Svalbard, Norway and northern parts of Canada segregated in the **Panboreal supraarea**.

4. Renewal of taxonomic composition and increase of association diversity in the Siberian area are characteristic for the time of paleotemperature increase and/or the rise of the World Ocean resulting in immigration of conodonts from the Tethys to the northern seas.

5. To find such stratigraphic intervals (surface levels) corresponding with the time of the leveling of fauna taxonomic composition is of great importance, since it lets researchers correlate accurately Boreal and Tethyan regions.

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