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The Problem of the Lower Triassic Subdivision and some Remarks to the Position of the Permian-Triassic Boundary

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Skyth
Perm-Trias-Grenze
Otoceras-woodwardi-Zone
Conodonten

Contents

Das Problem der Untergliederung der Untertrias und einige Bemerkungen zur Position der Perm-Trias-Grenze

Zusammenfassung

Die untertriassischen Faunen und Faunenabfolgen sind ungenügend bekannt. Daher ist die endgültige Entscheidung, ob die Untertrias nur eine Stufe (Skyth) umfaßt oder in zwei, drei oder vier Stufen unterteilt werden sollte, verfrüht. Abstimmungen über die Unterteilung der Untertrias auf Konferenzen, wo die Mehrzahl der abstimmenden Teilnehmer niemals auf dem Gebiet der Untertrias-Stratigraphie gearbeitet hat und den Umfang der stratigraphischen Einheiten nicht kennt, über die abgestimmt wird, sind „kontraproduktiv".

In der Tethys überlappt die Reichweite von *Otoceras* die Reichweite von *Ophiceras*. Die Conodontenart *Hindeodus parvus* beginnt gleichzeitg mit dem Einsetzen von *Ophiceras*. Sie erscheint im mittleren Teil der *O. woodwardi*-Zone am gondwaniden Südrand der Tethys, aber oberhalb der *O. boreale* Zone im borealen Faunenreich. Daher beginnt *Otoceras* in der Tethys nicht nur später als im borealen Faunenreich, sondern es reicht in der Tethys auch höher hinauf (bis in die *Ophiceras*-Faunen). Die erste primitive *Isarcicella* (*I. turgida*) beginnt etwas später als *H. parvus*. Sowohl das erste Einsetzen von *H. parvus* als auch das geringfügig jüngere erste Einsetzen von *Isarcicella* sind weltweit erkennbare Marken, die die Korrelation des tethyalen und borealen Faunenreichs ermöglichen, die mit Ammoniten nicht möglich ist. Beide Marken sind für die Definition der Perm-Trias-Grenze geeignet. Sie sind beide wesentlich jünger als das diachrone erste Einsetzen der borealen Ammonitengattung *Otoceras*.

Abstract

The Lower Triassic faunas and faunal successions are insufficiently known. Therefore the final decision, whether the Lower Triassic should be regarded as one stage or subdivided into two, three or four stages, is premature. Votings about the Scythian subdivision on conferences, where the majority of the voting participants has never worked on Scythian stratigraphy and do not know even the scope of the stratigraphic units about the use of which has been voted, are "contraproductive".

The range of *Otoceras* overlaps the range of *Ophiceras* in the Tethys. The conodont species *Hindeodus parvus* s.str. begins contemporaneously with the appearance of *Ophiceras*. It appears in the middle part of the *O. woodwardi* Zone on the Gondwanide southern margin of the Tethys, but above the *O. boreale* Zone of the Boreal realm. Therefore *Otoceras* begins not only later in the Tethys than in the Boreal realm, but it ranges there also into the younger *Ophiceras* faunas. The first primitive *Isarcicella* (*I. turgida*) begins a little later than *H. parvus*. Both the first appearance of *H. parvus* and the a little younger first appearance of *Isarcicella* are world-wide recognizable events that allow the correlation of the Tethyan and Boreal scales which are not correlable by ammonoids. Both events are suitable for the definition of the Permian-Triassic boundary. Both events are considerably younger than the diachronous first appearance of the Boreal ammonoid genus *Otoceras*.

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1. Remarks to the Problem of Lower Triassic Subdivision

During the Triassic Workshop in Lausanne (October 21–23, 1991) a meeting of the STS took place, in which the participants of the Workshop voted about the Lower Triassic subdivision. In this voting a two-fold subdivision of the Lower Triassic got somewhat more votes than the discrimination of only one Scythian stage. Unfortunately this voting took place without discussion of the contents of the different stages. Even the often changed scope of the Induan and Olenekian stages that were preferred by the majority of the participants was not discussed and not compared with the scope of the well defined terms Brahmanian, Gandarian, Griesbachian, Dienerian, Smithian and Spathian (independently from their rank as stages or substages).

The same procedure had happened some years ago with the Nammalian stage of GUEX (1978) in a three-fold subdivision that was in the beginning generally accepted. Today the Nammalian is totally rejected despite the fact that no new data have been proposed.

The Brahmanian was established by MOJSISOVICS, WAAGEN & DIENER (1895) for the *Otoceras* Beds of the Himalayas, the Lower Ceratite Limestones and the Ceratite Marls of the Salt Range. It was the best defined stage of the Tethyan Triassic, despite the fact that it was not defined in a single stratotype, but by beds and ammonoid faunas of two different, but near related areas (Himalayas and Salt Range).

The Gandarian substage was established for the Lower Ceratite Limestones and Ceratite Marls of the Salt Range. It corresponds to the (Upper Griesbachian and) Dienerian stage (Lower Scythian s. str. without the *Otoceras woodwardi* Zone).

The Induan and Olenekian have been defined for Boreal ammonoid faunas by KIPARISOVA & POPOV (1956). The name Induan, however, was taken from the Indian Subcontinent, because of the complete and ammonoid-rich development of the Lower Scythian along its northern margin. The *Otoceras woodwardi* Zone of the Himalayas defined the base of the Induan and the Ceratite Sandstone of the Salt Range defined originally the top of this stage. In this scope, the Induan was clearly different from the Lower Scythian stages and Substages (Brahmanian, Gandarian) proposed by MOJSISOVICS, WAAGEN & DIENER (1895). However, the Ceratite Sandstone is according to its ammonoid and conodont faunas a time equivalent of almost the whole Lower Olenekian (Smithian sensu TOZER, 1967). The originally defined Induan is therefore a useless stage that comprises the largest part of the Scythian (with exception of the upper Smithian and Spathian). For this reason, KIPARISOVA & POPOV (1964) excluded the Ceratite Sandstone from the Induan. By this new definition, the Induan became a perfect junior synonym of the Brahmanian sensu MOJSISOVICS, WAAGEN & DIENER (1895), defined with the same beds in the same area.

The Brahmanian and Gandarian have because of the priority, their well defined and unchanged scope in their stratotypes, their definition in the Tethyan realm and their well known faunal content (both ammonoids and conodonts of their type areas are well studied) the preference against all stages and Substages established in the Boreal realm. If the *Otoceras woodwardi* Zone would be finally placed in the Triassic, the term Brahmanian has the preference. If the *Otoceras* faunas will be placed in the Permian, the term Gandarian has the preference.

The terms Griesbachian, Dienerian, Smithian and Spathian have been well defined in Arctic Canada by TOZER (1967 and later papers).

Before the decision, whether one Scythian stage or two, three or four Lower Triassic stages should be used, the radiometric age data for the Lower Triassic should be restudied (so far 3.9 my according to HARLAND et al. [1989], that is 3.5 times shorter than the Norian stage and 3 times shorter than the Carnian stage), the pelagic Lower Triassic faunas have to be well studied (taxonomy, stratigraphic ranges), and the faunal turnovers within the Lower Triassic should be evaluated. Only after all these works, that still have to be done to a large part, votings about the subdivision of the Lower Triassic seem to be useful. In the present stage of our knowledge, such votings are "contraproductive", if the majority of the voters do not know the original content of the voted stage candidates.

2. Remarks to the Position of the Permian-Triassic Boundary

The Permian-Triassic boundary is not yet fixed. Two levels are favoured in the last time: The base of the *Otoceras (Julfotoceras) concavum* Zone favoured by the workers of the Boreal Triassic, and the base of the *Ophiceras* faunas favoured by the present author (KOZUR, 1989) and several workers on the Tethyan Triassic.

There is general agreement that the base of the Triassic should coincide with the top of the Changxingian, but there is disagreement, whether the *Otoceras* faunas are partly or entirely an equivalent of the Upper Changxingian or younger than the Changxingian. There is also general agreement that the *Otoceras* faunas began earlier in the Boreal realm than on the Gondwanide southern margin of the Tethys.

According to the conodont data, the *O. boreale* Zone is contemporaneous with the Upper Changxingian (KOZUR, 1989). No conodonts are known from the *O. concavum* Zone. The *O. boreale* Zone was so far by all authors correlated with the *O. woodwardi* Zone of the Tethyan southern margin. However, both the ammonoid- and conodont data show that at least the upper part of the *O. woodwardi* Zone is younger than the *O. boreale* Zone.

Still in the upper *O. boreale* Zone, the genus *Hindeodus* is represented by *H. typicalis* (SWEET) and transitional forms between this species and *H. julfensis* (SWEET), as seen from the conodont faunas in the *O. boreale* zone of Greenland (SWEET, 1976). True *Ophiceras* is still missing in these beds. On the other hand, *Ophiceras* is present in the upper half of the *O. woodwardi* Zone. The conodont fauna of this level is characterized by typical *Hindeodus parvus* (KOZUR & PJATAKOVA) and first primitive representatives of *Isarcicella* occur in this level (MATSUDA, 1981). These conodonts occur only above the *O. boreale* Zone. For this reason, the upper *O. woodwardi* Zone seemingly overlaps the *Ophiceras commune* Zone of the Boreal Triassic. This is confirmed by the discovery of *Otoceras* in beds with *Claraia stachei* BITTNER (Upper Griesbachian, Ellesmerian) in western Spitzbergen by NAKAZAWA et al. (1987).

The transitional beds of the uppermost Changxingian of South China (by many authors regarded as post-Changxingian because of the occurrence of doubtful specimens of *Otoceras*? sp.) are largely older than the upper *O. woodwardi*

zone, because they contain still *Hindeodus julfensis* (SWEET). The former reported occurrence of a specimen of *H. parvus* (KOZUR & PJATAKOVA) in these beds (KOZUR, 1989) could not be confirmed by newer investigations of conodont faunas from the transitional beds during my stay in Nanjing in autumn 1991. May be that this specimen is a juvenile *Hindeodus latidentatus* (KOZUR, MOSTLER & RAHIMI-YAZD). This species is beside *H. typicalis* (SWEET) and *H. julfensis* (SWEET) common in the transitional beds. Juvenile representatives of this species are similar to *H. parvus* and nearly inseparable from this species, if the main cusp is broken away what is the case in the only known specimen from the transitional beds attributed to *H. parvus*.

DAGIS & DAGIS (1987) regarded the transitional beds after careful analysis of their ammonoid fauna as typical Permian (Changxingian), in agreement with KOZUR (1980, 1981, 1989) and in agreement with the original definition of the Changxingian by ZHAO et al. (1978). DAGIS & DAGIS (1987) rejected the view that *Otoceras* is present in the transitional beds. In this case, no "Triassic elements" are known in the transitional beds that consist of Permian brachiopods, conodonts and the "Triassic" ammonoid genus *Otoceras* beside typical Permian ammonoid genera, such as *Pseudogastrioceras*, the last representative of the goniatites, and *Pleuronodoceras*. As shown by KOZUR (1989), *Otoceras* is a Permian element as well. So, seemingly, in the Tethys the Permian elements survived longer than in the Boreal realm, if we do not follow DAGIS & DAGIS (1987) that the transitional beds are older than the *O. concavum* Zone. The conodont fauna of most of the transitional beds with *Clarkina changxingensis* (WANG & WANG), *C. deflecta* (WANG & WANG), *C. subcarinata* (SWEET), *Hindeodus julfensis* (SWEET), *H. latidentatus* (KOZUR, MOSTLER & RAHIMI-YAZD) and *H. typicalis* (SWEET) has distinct Permian character.

Seemingly the first appearance of *Hindeodus parvus* s.str. and of *Ophiceras* is contemporaneous, independent, whether *Otoceras* is still present (Kashmir) or absent (South China). Probably this datum coincides with the first appearance of *Claraia wangi* (PATTE) or this species begins a little later, together with the first primitive *Isarcicella*, *I. turgida* (KOZUR, MOSTLER & RAHIMI-YAZD).

H. parvus (KOZUR & PJATAKOVA) and the ammonoid genus *Ophiceras* begin in the middle part of the *O. woodwardi* Zone, but seemingly above the *O. boreale* Zone.

These data are confirmed in a continuous Permian–Triassic section of Sicily. Typical Changxingian conodont faunas with *C. changxingensis* (WANG & WANG), *C. deflecta* (WANG & WANG) and *C. subcarinata* (SWEET) are here directly overlain by beds with typical *H. parvus* (KOZUR & PJATAKOVA). There is no sedimentologic break at the P/T boundary. Only the colour of the claystones changes from red to yellowish-brown (colour of weathered claystones). A distinct tectonic impulse occurs 2 m above the first appearance of *H. parvus*. There also the first primitive *Isarcicella* begin.

Both the first appearance of *H. parvus* (KOZUR & PJATAKOVA) and the first appearance of primitive *Isarcicella* would be suitable for definition of the P/T boundary. Both these boundaries are situated considerably above the first appearance of *Otoceras* in the Boreal realm and even above the later appearance of *Otoceras* on the southern margin of the Tethys. These boundaries are situated above the *Otoceras boreale* Zone in the Boreal realm and within the upper *O. woodwardi* Zone on the southern margin of the Tethys. Both boundaries are world-wide recognizable both in pelagic, ammonoid-bearing and shallow-water ammonoid-free deposits. Both boundaries are situated near to the top of the type Changxingian (in the uppermost transitional beds or at the top of the transitional beds).

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