

CONODONTS OF THE *OTOCERAS* BED OF SPITI

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ABSTRACT

Otoceras bed is taken to mark the base of the Triassic System in Spiti and in other sections of the world. The rock samples from two well known sections were recently analysed for their conodont content. The *Otoceras* Zone is observed to be thicker in Spiti than the earlier records. The entire thickness of the zone, however, has good yield of conodonts. It contains mainly platform conodonts, a few of which characterise late Permian strata elsewhere. The *Otoceras* Zone is succeeded by *Ophiceras* bed (or *Ophiceras* Zone). The *Ophiceras* bed reveals first appearance of *Neospathodus*, a dominantly Triassic element, at the base.

A somewhat similar picture appears to emerge from the preliminary data from Zaskar and Kumaun sections of Central Himalaya.

Thus the status of *Otoceras* Zone based on conodonts indicates greater affinity towards Dorashamian (youngest stage of late Permian) rather than early Triassic. It is therefore suggested that the status of the base of Triassic System at the base of *Otoceras* Zone be critically reviewed keeping in mind the conodont biostratigraphy, which has been elaborated in this report.

The *Otoceras* Zone has been provisionally assigned to *Gondolella orientalis* *G. subcarinata* Assemblage Zone (Upper Permian) in the framework of conodont biostratigraphy.

INTRODUCTION

Measurement of, and conodont investigation in the Triassic succession of Spiti is being carried out since 1976 under the aegis of International Geological Correlation Programme Project No. 4—The Triassic of the Tethys Realm. A number of critical and classical sections have since been measured and sampled, including the most well-known Lalung (Lilang). Several rock samples from many sections have been dissolved to examine their conodont content. The results will be revealed in a series of forthcoming publications.

The present paper records the conodont yield of the *Otoceras* bed, which is taken to mark the basal bio-unit of the Triassic succession in the region. The *Otoceras* fauna is also taken to signify the beginning of Triassic time in the currently accepted world standard (Silberling and Tozer, 1967 and Tozer, 1978).

The *Otoceras* bed conodonts of Spiti sections recorded in this paper, however, support latest Permian age for this stratigraphically important ammonite bed.

It is endeavoured here merely to record an observable conodont data without entering into inferential controversy; evidently, this data is also significantly linked to the fluidal status of Permian-Triassic boundary.

Before we deal with the conodont yield of the *Otoceras* bed, it may be important to mention here that a recent preliminary study of our collection from Lalung (Lilang) by two of us (Bhatt and Joshi, in press) has clearly shown that the thickness of this ammonite bed in Spiti is significantly different than recorded so far (Hayden, 1904; and Diener, 1912). Further appropriate details con-

cerning this discovery will be dealt with at proper place in the text.

STRATIGRAPHIC AND SAMPLING DETAILS

The samples for the present investigation have come from the Lalung¹ Section (Fig. 1). However, further research in the material of Spiti River Section (Bhatt and Joshi, 1978) has also been utilized here (Fig. 2). Taking cognisance of the present results, it is but apparent that the data put forth earlier by two of us was in the nature of preliminary observations.

The *Otoceras* bed of Spiti consists of a band of massive, dark-grey limestone, weathering to rusty brown colour. The said brownish tinge is more prevalent in the lower part of the bed and is most pronounced on its basal surface where it comes in contact with the top limonitised layer of the underlying Productus Shale (Bhatt *et al.*, 1980). The base of the bed is often observed to be encrusted with highly weathered (limonitised) ammonite fossils. Amongst the mega-fossils present in the bed are *Otoceras woodwardi*, several species of *Ophiceras* and *Glyptophiceras himalayanum*.

The massive limestone bed, representing the zone of *Otoceras*, is overlain by a bed of flaggy limestone into which *Otoceras* does not range and the mega-fauna of this higher bed consists of several species of *Ophiceras*, *Claraia* and *Glyptophiceras himalayanum*.

¹The current spelling of the earlier Lilang village, where from the name of the now classical section was borrowed by the pioneers. Bhatt and Joshi (in press) have referred to this as Lingti Section due to lack of sufficient information until then.

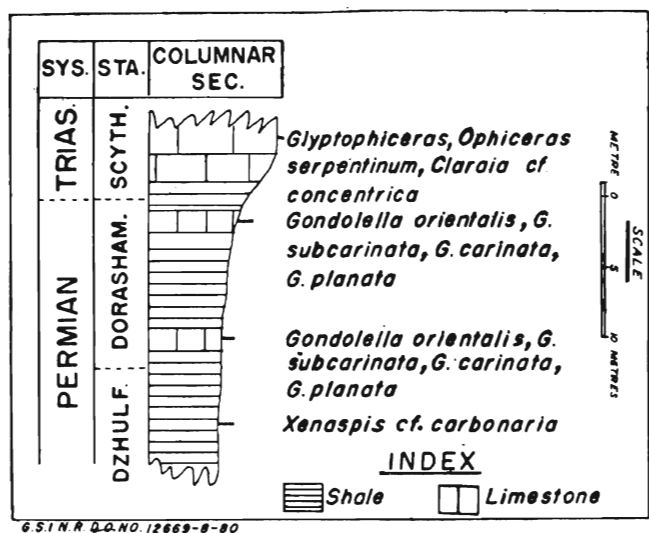


Fig. 3. Biostratigraphically significant conodonts, ammonoids and bivalve in the Tangze Section, Zanskar, Ladakh (modified after Joshi and Arora, 1979).

The Productus Shale that underlies the *Otoceras* bed has been recently dated as Dzhulfian nearly up to its youngest levels on ammonoid basis (Bhatt *et al.*, 1980) ; however, several rock samples obtained from it have not yielded any conodont so far¹.

We, therefore, provisionally define the *G. orientalis*—*G. subcarinata* Assemblage Zone as spanning the *Otoceras* bed of Spiti.

KUMAUN AND ZANSKAR SECTIONS

One of us (DKB), recently had the opportunity of preliminary conodont investigation in the *Otoceras* bed samples from the well-known Shalshal Cliff Section in the Kumaun Himalaya which were kindly placed at his disposal by colleagues in the Geological Survey of India—M/s B. S. Jangpangi, A. Sehgal and Dr. A. K. Kackar. They collected the material in the summer of 1979. It is significant to record here that one of the samples from the base of the *Otoceras* bed in Shalshal Cliff has yielded *G. orientalis*, *G. subcarinata*, *G. planata* and *G. carinata*.

Yuger, Marling and Tangze sections in the Zanskar region of the NW Himalaya, which expose northwestern extension of the Spiti basin sediments, were investigated

¹The alleged occurrence of *N. novaehollandiae* as deep in the stratigraphic level as the uppermost layers of Dzhulfian Productus Shale (or Kuling Shale) in the Khar Section of Pin valley, Spiti (Goel, 1977), is a case of mistaken identity of *novaehollandiae* yielding stratigraphic horizon as revealed by a recent survey (Bhatt and Fuchs, in Press).

As the exposed section at Khar is along a dip slope, very often the eroded shaly strata from higher horizons in the section conceal considerably the Griesbachian carbonate bands which are thinly developed in the area (unlike in the Lalung Section where these are relatively thicker) and under the circumstances can easily be mistaken as minor carbonate bands within the Dzhulfian Productus Shale.

by Joshi and Arora (1979). They reported *G. carinata* in a zone 6 m above the horizon yielding *Xenaspis cf. carbonaria*, a common associate fossil of Dzhulfian *Cyclolobus walkeri* in the Productus Shale sequence of Spiti, in the Tangze Section. However, re-examination of their *G. carinata* material by the authors has now established substantial presence of *G. orientalis*, *G. subcarinata* and *G. planata* in the assemblage. Though *Otoceras* was not recorded here, the level of samples as it is, lying younger than the *X. cf. carbonaria* horizon but stratigraphically older to the bed with *Clariaia cf. concentrica* and *Ophiceras serpentinum*, makes it obvious that it represents the horizon of *Otoceras* bed (Fig. 3).

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EXPLANATION OF PLATES

PLATE I

(All magnifications X80, except where mentioned. All the specimens are coated with MgO).

- 1, 2, 3 & 7. *Gondolella carinata* Clark; 1, 2 & 3, bottom, side and top views, sample no. LLG 12, Spiti River Section; 7, top view, sample no. LG62; 3, X70.
- 4, 5 & 14-17. *G. orientalis* Barskov and Koroleva; 4 & 5, top and bottom views, sample no. LLG 10, Spiti River Section; 14-17, top, bottom, top and bottom views, sample nos. LG62 and LG 63; 15-17, X50.
- 9-13. *G. cf. orientalis* Barskov and Koroleva; 9-11, oblique, bottom and side views, sample no. LLG12, Spiti River Section; 12 & 17, top and side views, sample no. LG61; 12, X115 & 17, X130.
- 6, 8 & 18-19. *G. subcarinata* (Sweet); 6, little oblique view, sample no. LLG12, Spiti River Section; 8, top view, sample no. LG62; 18-19, oblique and bottom views, sample no. LG63; 18-19, X50.
- 20-22. *G. planata* Clark; 20 & 21, top and bottom views, sample no. LG61; 22, top view, sample no. LG62.

PLATE II

(All magnifications X80, except where mentioned. All the specimens are coated with MgO).

- 1, 4, 11, 12 & 19. *Gondolella orientalis* Barskov and Koroleva; 1 & 4, top views, sample nos. LG65 & LG66; 11 & 12, top and bottom views *Otoceras* bed, Shalshal Cliff Section, Kumaun Himalaya; 19, top view, Tangze Section, Zaskar, Ladakh; 11 & 12, X 60.
- 2-3. *Anchignathodus typicalis* Sweet; side and top views, sample no. LG65.
5. *Neospathodus novaehollandiae* Mc Tavish; top view, sample no. LG67, X145.
- 6, 14, 15 & 18. *Gondolella planata* Clark; 6, top view, sample no. LG67; 14, 15 & 18, top, bottom and top views, *Otoceras* bed, Shalsha Cliff Section, Kumaun Himalaya.
- 7, 8, & 13. *G. carinata* (Sweet); 7-8, top and bottom views, sample no. LG 67; 13, top view, *Otoceras* bed, Shalshal Cliff Section, Kumaun Himalaya.
9. *Neospathodus praekummeli* Bhatt, Joshi and Arora; side view, sample no. LG 67.
10. *N. kummeli* Sweet; side view, sample no. LG 67.
- 16, 17, 20-21. *Gondolella subcarinata* (Sweet); 16-17, top and bottom views, *Otoceras* bed, Shalshal Cliff Section, Kumaun Himalaya; 20-21, top and bottom views, Tangze Section, Zaskar, Ladakh.

