magnetic zones in the stratotype is greater than in the Tethys sections.

Correlation of the Upper Permian stages in the West is possible through Pechora Urals, Novaya Zemlya, Canadian Arctic to North America, and through Aktyubinsk Urals, Kazakhstan, Juzbass, Far East, and China to Japan and Australia in the East.

Dominance of marine sections, as well as impossibility of their correlation with continental ones require new correlation standards. Dalonkgou section of North-West China is suggested to be continental Upper Permian stratotype. We repeatedly drew geologists and paleontologists' attention to the fact that the boundary of the Lower and Upper Tatarian Substages is considered to be the Permian and Triassic boundary. This section requires additional paleontological and magnetostratigraphic studies.

3. How many series and stages? That depends on the basic criterion. There are many factors which affect formation of the Permian. Currently, the two series reflect two stages in the basins development: Early Permian - deep marine stage, and Late Permian - shallow marine-lacustrine stage. Change of thalassocratic conditions into geocratic ones is global, and can serve as a reliable criterion.
4. Position of the Permian boundaries. A. We believe that, before solving this matter, the boundaries of global correlation should be determined. In the Late Permian, such are the boundary between the Solikamian and Sheshmian horizons within the Ufimian with change of lowering into uplifts, restructuring of biological matter, and the boundary between the Urzhumian and Severodvinian horizons within the Tatarian that practically coincides with the boundary between Kiama and Illawarra hyperzones. The Upper Tatarian Substage claims to be a Stage. Volumes of horizons, stages, series indicate, as a rule, the level of our knowledge at the present time; and unequivocal understanding of them in different regions matters much more than their correct determination.

The problem of correlation was the most complicated one which incurred criticism on the East Europe stratotypes. That is solvable for the Ufimian and Kazanian if, except conventional faunal groups, paleomagnetic, flora, and palynological methods are used, and conodonts are studied. The Tatarian is more complicated in this respect. Here, fish remains and paleomagnetic methods can help. Marking out of the third division of the Permian with Volga-Urals region is unlikely to make sense because the Tatarian formed in specific stable conditions.

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19. THE UPPER PERMIAN OF THE SALT RANGE AREA REVISITED: NEW STABLE ISOTOPE DATA

The Northern part of Great-India underwent an early rifting phase in the late Paleozoic, just at the end of the large scale Gondwanian glaciation. The beginning of the rifting processes is marked by large hiatus and discontinuities (paraconformities) between the early or middle Paleozoic sedimentary succession and the discontinuous middle-late Permian Traps and transgressive sediments. The Northern Indian passive margin consists of the present High and Lower Himalaya and a small part of the Indian craton and their sedimentary cover. The Permian rift shoulder is located in the Higher Himalaya, with part being in the underthrusted Lower Himalaya. The rim basin (landward of the shoulder) is well developed in the Pottawar - Salt Range area. The late Permian sedimentary evolution is characterised by two transgressive-regressive (T-R) second order cycles. The break-up of the rift occurred during the second cycle (late Dzhulfian). In the Salt Range area, these two T-R cycles have been subdivided in five third order sequences.

At the end of Permian, hiatuses, gaps and local erosion of part of the margin are direct consequences of a first order relative sea-level fall; this is also the time of the largest extinction event of the Phanerozoic that deeply affected the carbonate productivity and the stratal patterns.

The upper Permian to lower Triassic succession is well exposed in gorges that dissect the Salt Ranges - Trans-Indus Ranges of Northern Pakistan. The main studies on this area have been summarized in (Kummel and Teichert, 1970) and part of the recent literature in Wignall and Hallam (1993).

A huge carbonate platform (the Wargal Formation) is transgressing during late Murgabian - early Midian time. The first upper Permian transgressive-regressive cycle (T-R or second order cycle) is recorded in the growth and demise of this carbonate platform (Midian time). During the early Dzhulfian, a sudden terrigenous influx occurs, marking the boundary between the lower and the upper T-R cycles and a shallow water mixed carbonate - clastic ramp, the Chhidru Formation, overlies the Wargal carbonate platform (Pakistanis-Japanese, 1985).

The carbon isotope curve for the upper Permian exhibits two positive excursions: the first one is related to the Wargal Formation, and the second one to the Chhidru Formation. Comparison of the upper Permian $\delta^{13}C$ curves with sequence stratigraphic analysis shows a close correlation, both for the second order and third order cycles. Higher $\delta^{13}C$ values usually occur within the transgressive system tracts, reflecting the deposition of greater amounts of organic matter on the continental shelves during transgressions (Woodruff and Savin, 1985).

Similar relationships between the $\delta^{13}C$ curve and eustatic level have been reported in the upper Cambrian-lower Ordovician (Ripperdan et al., 1992), in the Cretaceous

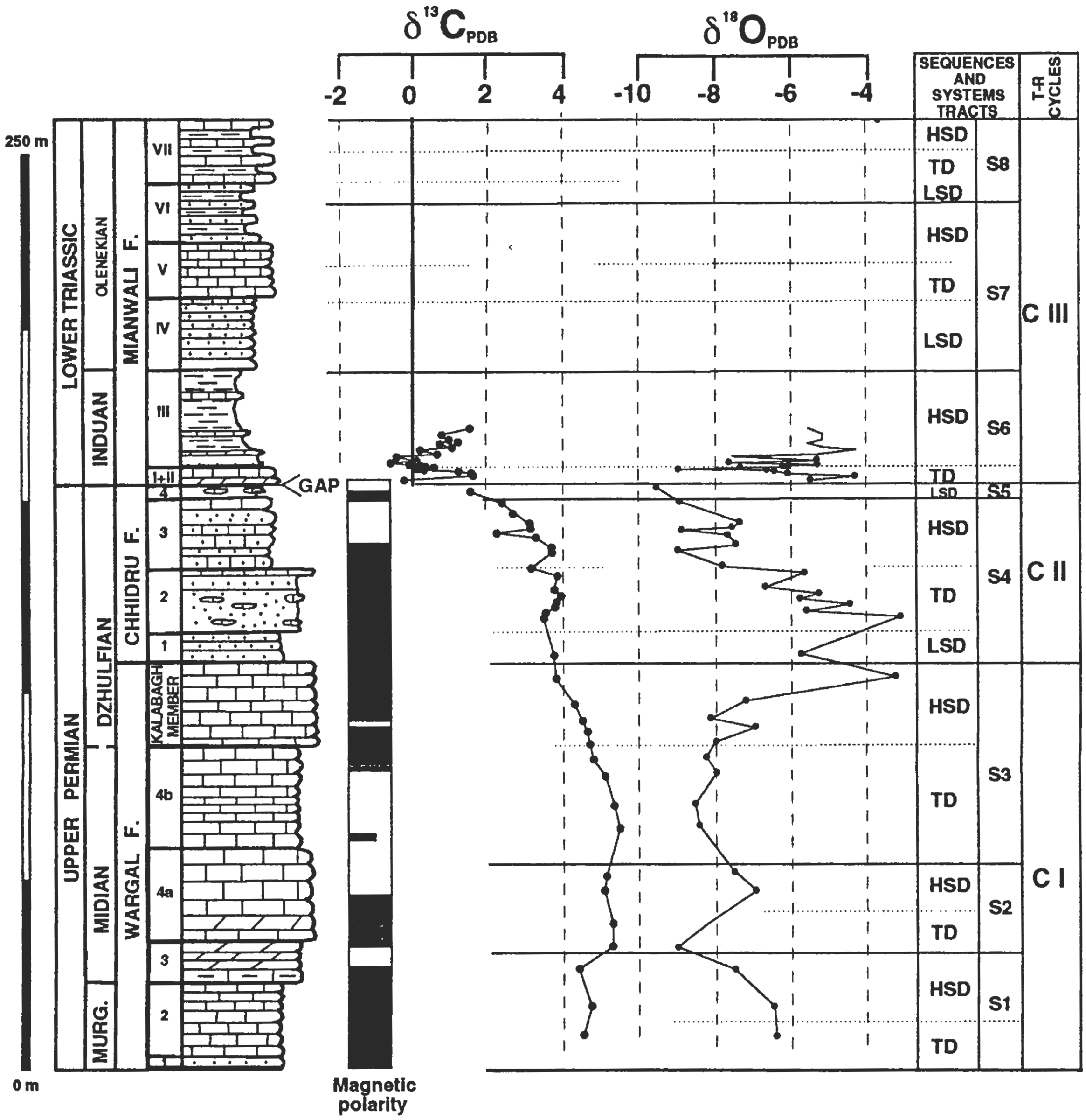

Figure 1 Carbon and oxygen isotope profiles of Nammal Gorge, Sequences, systems tracts and T-R cycles.
Magnetostratigraphy from Haag & Heller (1991).
LSD: lowstand deposits; TD: transgressive deposits; HSD: highstand deposits.

(Mitchell and Paul, 1994) and in the Miocene (Woodruff and Savin, 1985). However, similarities between long term fluctuations of $\delta^{13}C$ average values and sea level variations have been observed by Shackelton and Kennett (1975).

Oxygen isotope ratios are less consistent: in some intervals there is a crude correlation with $\delta^{13}C$ value variations, but not always. The oxygen isotope profile undergoes a major positive excursion of about 4‰ within the upper part of Kalabagh Member and the base of Chhidru Formation, but we do not believe this to reflect an original change in the isotopic composition of the seawater. Rather, it is related to diagenesis such as meteoric diagenesis, deep burial diagenesis and/or monsoon signature (Mutti and Weissert, 1995). The samples most depleted in ^{18}O are found at the top of Chhidru Formation. This indicates an exchange with ^{18}O depleted waters (James, 1984) after the end Permian regression phase and before the early Triassic transgression.

The magnetostratigraphic results for the upper Permian obtained by Haag and Heller (1991) from the Nammal Gorge section show 10 magnetic zones corresponding to the base of the Illawara mixed superchron. Due to the gaps at the base of the Wargal and at the top of the Chhidru Formations, the late Permian magnetic polarity time scale is not complete here. According to Menning (Oral comm.), the late Permian part of this Illawara mixed superchron comprises at least 15 magnetic zones, but does not specify positions.

Our interpretation of a hiatus between the Chhidru and the Mianwali Formation has been expressed in Baud et al. (1989). With respect to age, we now agree with Nakazawa (1993) that part of the early Griesbachian is recorded in the lower and middle Kathwai dolomite. This is also the opinion of Wignall and Hallam (1993), but for the PJRG (1985), the Permian-Triassic boundary occurs between the lower and middle unit of the Kathwai Member.

We can confirm the drastic drop of $\delta^{13}C$ from the high positive values that characterised the upper Permian to lower values in the lower Triassic marine sediments.

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