

Lithostratigraphy and carbonate microfacies across the Permian-Triassic boundary near Julfa (NW Iran) and Abadeh (Central Iran)

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Abstract

Permian-Triassic boundary sections in the regions of Julfa (NW Iran) and Abadeh (Central Iran) display three characteristic rock units: (1) the *Paratirolites* Limestone (4-5 m thick) with the mass extinction horizon (P-Tr extinction event) at the top surface (Fig. 1-3), (2) the Boundary Clay (0.5–2 m thick; Fig. 4,5), and (3) the Elikah or Shahreza formations with the conodont P-Tr boundary near the base (Fig. 6).

The *Paratirolites* Limestone is the uppermost of the Permian carbonate formations; it is typically developed in the Julfa area but occurs similarly in Central Iran. It is an about four to five metres thick unit of pelagic red nodular marly limestone composed of beds with 5-30 cm thickness. A conspicuous accumulation of sponge remains occurs at the top of the highest 4–5 cm thick bed of the *Paratirolites* Limestone; it marks the extinction horizon. Thin sections show an about 2 cm thick horizon of sponge packstone with more or less articulated skeletons of siliceous sponges, which are embedded in micritic matrix. The Boundary Clay is a red claystone with marly nodules and few thin light-green horizons. Few thin (up to 10 cm) horizons of marly limestone within this unit are sponge wackestones and burrowed ostracod lime mudstones. In contrast to the sections near Julfa, the Boundary Clay in Central Iran is made up by black and dark grey shale with a total thickness reaching 2.00 metres. In the transition from the Boundary Clay to the overlying grey platy limestone beds of the Shahreza Formation occur one or more enigmatic ‘calcite fan’ layers (Fig. 5), of probably inorganic origin. The earliest Triassic carbonate Elikah and Shahreza formations comprise thin-bedded yellow and grey limestone beds; the microfacies succession comprises bellerophontid and gastropod wackestone and grainstone as well as laminated bindstone, peloidal packstone, and oncoid floatstone.

The study of the microfacies leads to the result that the depositional regime began to change in some distance below the extinction horizon. The condensed marly limestone of the upper part of the *Paratirolites* Limestone may record a period of a very slow carbonate accumulation. This is evident in form of an increasing number of reworked hardground clasts, bored and encrusted bioclasts and lithoclasts, ferruginous crusts, and dissolved cephalopod shells. A complete demise of the carbonate factory occurs within the Boundary Clay. The skeletal carbonate factory was restored with the deposition of platy, micritic limestone at the base of the Elikah Formation about 1.50 m above the extinction horizon. Micritic, skeletal, and microbial limestone with thrombolitic/ stromatolitic structures and oncoids are predominant here.

The carbonate microfacies study show that the facies changes started in the Late Permian *Paratirolites* Limestone, below the actual P-Tr extinction event, and before the conodont P-Tr boundary. There is no evidence of a pronounced sea level drop around the P-Tr boundary in these sections.