Reconstruction of bottom-water oxygenation conditions in the Late Permian Neo-Tethys

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The end-Permian mass extinction, the largest extinction in Earth's history, was coincident with widespread oceanic anoxia. The timing of the onset of the event is uncertain and likely varied within and between ocean basins. In this study, we present framboidal pyrite size distributions, $\delta^{34}S_{pyr}$ values, and sulfur to carbon (S/C) ratios for three Late Permian sections (Mud, Lingti, Attargoo) from the southern Neo-Tethys (Spiti Valley, Himachal Pradesh, India) to determine bottom-water oxygenation conditions of this region. Each section consists of black to silty shales from the Late Permian Gungri Formation which is uncomformably overlain by a 5-10 cm ferruginous layer (FL). The FL is thought to be a gap in sedimentation and broadly marks the transition from the Late Permian shales to the Early Triassic limestone consequently encompassing the Permian-Triassic boundary for these sections. This study seeks to identify the long-term trends in oxygenation conditions during the Late Permian, prior to the end-Permian extinction, for this understudied region in the Neo-Tethys, using pyrite framboid size distributions, S/C, and S isotope ratios. The diameter of individual pyrite frambiods is measured using a Scanning Electron Microscope in backscatter electron mode. Pyritic sulfur was extracted using the chromium reduction method and isotopes values are measured by Isotope Ratio-Mass Spectrometry. Organic C concentrations were measured by elemental analysis.

Results suggest that, in the Late Permian, the bottom-waters of the southern Neo-Tethys experienced consistent anoxia to euxinia well prior to the Permian-Triassic transition. However, oxygenation conditions shift to mainly dysoxic with epsiodic euxinic intervals directly below the FL. Nevertheless, this study suggests that oxygen limititation was present in the bottom-waters of the southern Neo-Tethys on a long period of time (Wuchiapingian-Early Changhsingian) well prior to the end-Permian extinction.