# Depositional environments and diagenesis of Jurrasic Isha Formation, Isha section, north Waziristan, Pakistan

Islam Ullah[1], Saad Khan[1*], Shuja Ullah[1], Fahim Ullah[2]

[1] *National Centre for Excellence in Geology, University of Peshawar, Peshawar Pakistan*

[2] *Bacha Khan University Charsadda, Charsadda, Pakistan*

**Email: saadkhan@uop.edu.pk*

This study focuses on the petrographic examination of the Jurassic Isha Formation at the Isha section, located within the axial belt of North Waziristan, Khyber Pakhtunkhwa, Pakistan. The investigation aims to interpret its microfacies distribution, depositional conditions, and diagenetic alterations. Field observations indicate that the formation predominantly consists of dark grey limestone, interspersed with dolomite of a similar hue. Occasional brownish limestone beds are also noted. The formation is characterized by an extensive network of calcite veins, fractures, stylolites, and a distinctive stockwork geometry in calcite veining, along with butcher-chop weathering patterns.

A petrographic analysis of twenty-four thin sections led to the identification of seven distinct microfacies (MF1–MF7): Dolomudstone (MF1), Mudstone (MF2), Bioclastic Mudstone (MF3), Bioclastic Peloidal Wackestone (MF4), Peloidal Packstone (MF5), Ooidal Grainstone (MF6), and Bioclastic Ooidal Grainstone (MF7). These facies reflect diverse depositional settings. The petrographic study also revealed multiple diagenetic modifications, including micritization, neomorphism, compaction, fracturing, and cementation. Additional diagenetic features such as dissolution, dolomitization, and pyritization were also identified. Various types of cement—equant or blocky calcite, drusy calcite, and isopachous cement—were observed. Physical compaction and dissolution are evident in some facies, with features like closely packed grains and saw-tooth stylolites. The presence of dolomitization and pyritization suggests deep burial diagenesis.

Calcite veins observed in the samples suggest late-stage diagenetic processes such as telodiagenesis. Based on microfacies classification, MF2, MF3, MF4, and MF5 indicate a lagoonal environment, while MF6 and MF7 suggest deposition in carbonate shoal settings of the inner ramp. MF1 is linked directly to the inner ramp environment. The findings suggest that the Jurassic Isha Formation was deposited in an inner ramp setting comprising lagoons, shoals, and tidal flats, subsequently influenced by multiple diagenetic processes.

**Keywords**: Isha Formation; microfacies; diagenetic features; inner ramp; carbonate shoal.