Multiphase Dolomitization of the Shogram Formation, Devonian Platform Carbonates: Insights from Field, Petrography and Geochemistry

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The Shogram Formation, regarded as Devonian platform carbonates, within the Karakoram-Hindukush tectonostratigraphic basin is intensely dolomitized. The dolomitized bodies, varying in size and shape, are accompanied by tabular bodies of dolomite-cemented breccias and networks of dolomite veins. Three types of matrix dolomite can be categorized through field observations and petrography. It is evident from the overall results that the dolomitization occurred through a polyphase process involving hydro-fracturing, dissolution of the host rock, and subsequent dolomite precipitation. These dolomites exhibit distinct stable oxygen isotopic signatures, i.e., dolomite-1 and dolomite-2 display oxygen isotopic signatures similar to the Devonian carbonates, while dolomite-3 shows depleted oxygen isotopic signatures. Strontium isotopic signatures reveal similarities between dolomite-1, dolomite-2 and the Devonian signatures, while dolomite-3 and cement dolomite exhibit more radiogenic signatures. Fluid inclusion analysis suggests elevated temperatures (170 to 230°C) for the dolomitizing fluids, indicating a fossil hydrothermal system. This process is likely driven by the episodic expulsion of over pressured fluids through fault and fracture systems. Dolomite-1 and dolomite-2 are interpreted to have formed in shallow burial or near-surface conditions. Moreover, dolomite-3 and dolomite cement are interpreted to be hydrothermal. The hydrothermal system likely stems from deep- rooted faults, implying substantial faulting activity during the deposition interval of Devonian Shogram Formation. This study contributes significantly to understanding the complexities of dolomitization processes and their geological implications in similar geological settings.