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Evidence of multi-stage serpentinization from the Mesoarchean Holenarsipur Greenstone Belt, Western Dharwar Craton, southern India

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The Dharwar Craton in South India is one of the classic Archean terrains, records signatures of Paleo-Mesoarchean geological processes. The serpentinized ultramafic rocks from the Holenarsipur Greenstone Belt (HGB), Western Dharwar Craton, provides an opportunity to understand the alteration mechanisms and their impact on whole rock compositions. Serpentinization is a hydrothermal alteration process that generates different types of serpentine polymorphs, [1]. It notably occurs during the alteration of oceanic lithosphere in slow and ultra-slow spreading ridges and in subduction zones. Serpentinization plays potential role in understanding origin and evolution of primordial life and recycling of water and fluid mobile elements into the deeper mantle.

Based on textural characteristics, the serpentinized rocks from the HGB are classified into three groups; serpentinites without pseudomorphic mesh textures, serpentinites with pseudomorphic mesh textures, and serpentinites with well-developed magnetite veins [2]. Through mineralogical and laser Raman spectral studies, three serpentine polymorphs are identified, namely lizardite, antigorite, and chrysotile. The serpentinization of ultramafic rocks occurred in at least three stages and the relative chronology is inferred as lizardite → antigorite → chrysotile. The geochemical systematics of ultramafic rocks reveal komatiitic affinity as well as dominance of olivine and spinel in the protolith. The major and trace element budget of these rocks are primarily controlled by melt/ rock or fluid/rock interaction during serpentinization. From the fluid mobile element systematics, the ultramafic rocks from central and southern parts of the belt exhibit signatures of fluid/ rock interactions during serpentinization rather than melt/ rock interaction. The fluid rock interaction may have taken place in two potential ways: in a subduction setting, where the mantle wedge is hydrated due to fluid release from the descending plate, or at a divergent margin, where fractures and detachment faults serve as conduits for the flow of hydrothermal fluids.

References

[1] Evans B W (2004), International Geological Reviews 46, 479–506.

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