Nature and evolution of the Tethyan Mantle evidenced by the Dras peridotites, Ladakh Himalayas, India.

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Introduction and Geological Settings

Prominent exposures of the neo-Tethyan mantle rocks in the form of peridotites are observed extending in the E-W direction and have a maximum width of 1.5 km at the Dras village, Ladakh, India (Fig. 1). The peridotites, along with gabbros and radiolarian chert are thrust over the Dras volcanic rocks (Fig. 2, A, B, C). They are primarily dunites bearing chromite mineralization with minor harzburgites and pods of altered wehrlites. The chromite mineralization associated with dunites displays a variety of structures: banded, lenticular, pull-apart, schlieren, massive and disseminated (Fig. 2, A; inset i, ii, iii). Dunites have a blocky appearance due to a cross-cutting set of joints. At places, magnesite veins are observed forming an intricate network in dunites (Fig. 2, D; inset).

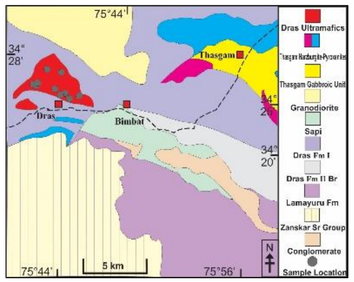


Fig. 1. Geological Map. (Modified after Reuber, 1989)

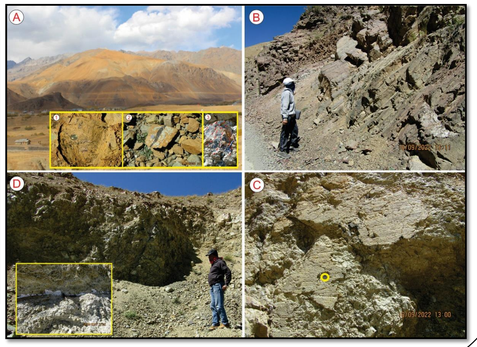


Fig. 2. Field and Outcrop images

Aim of the study

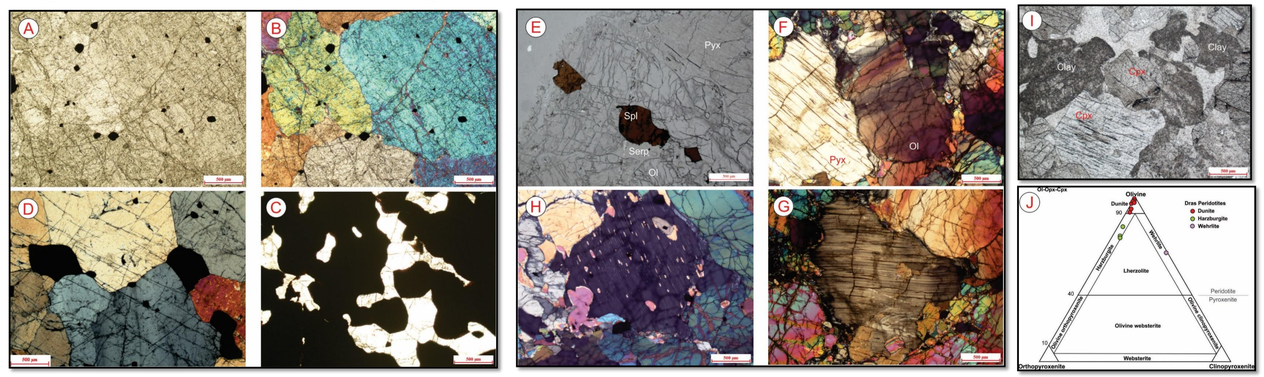
- Delineate various sub-units of Dras ophiolite and study their contact relations through field studies.
- Systematic sampling for petrological and geochemical fingerprinting of the rocks to understand the evolution of the Tethyan oceanic lithosphere.

Methods

- Field survey and sampling.
- Thin section petrology and mineral chemistry.
- Whole rock geochemical analysis

Petrographic Analysis

Fig. 3: A - D: Dunite in thin section, E – H: Harzburgite thin section, I: Wehrlite thin section and J: volumetric modal classification of Dras Peridotites.



- The dunites display protogranular textures (Fig. 3, A, B) which transition into equigranular mosaic textures (Fig. 3, D), typical of mantle peridotites. Olivines exhibit straight boundaries meeting at 120º, indicating recrystallization. Chromites occur as tiny inclusions disseminated throughout the rock or lodged on olivine triple junctions (Fig. 3, D).
- In harzburgite, porphyroclastic olivine displays kink bands. Orthopyroxenes (enstatite) are subhedral and have exsolution lamellae of clinopyroxene (dioside). Spinels are magnesio-chromites.
- Overall textures suggest that the peridotites have undergone progressive deep-seated deformation and solid-state recrystallization.

Whole – rock geochemistry

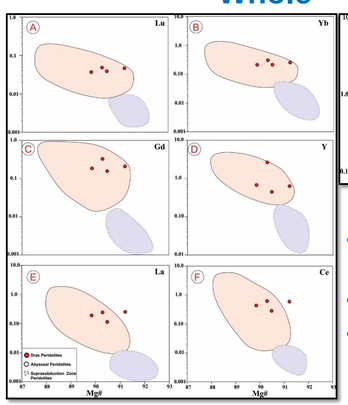


Fig 4. Mg vs REE plots for Dras peridotites

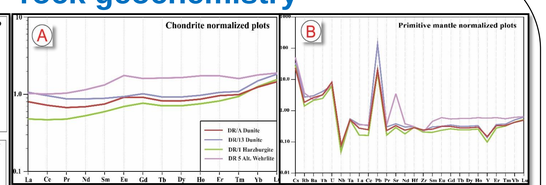


Fig 5. A. CI and B. PM normalized plots for Dras peridotites

- Peridotites are relatively fresh (LOI: 0.1-5 wt%) with high Mg# (89 – 91).
- Depleted in REEs and trace elements (Fig 5).
- Enriched in LILEs, especially Cs and Nb-Ta and Zr-Hf anomalies indicate formation/modification in a subduction tectonic setting (Fig 5. B).
- However, whole rock Mg# vs. REEs indicates abyssal peridotite affinities.

Mineral Chemistry

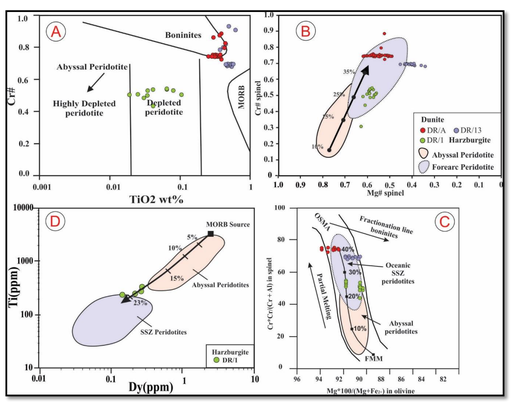


Fig 6. A- C Spinel mineral chemistry plots and D. Pyroxene trace element plots for Dras Peridotites

- Olivines display chemical zoning with rims rich in Mg - Cr (51.0 wt % and 0.1 wt % resp.) and cores rich in Fe (6.38 wt %).
- Spinels in dunites are chromites (Cr# 68-82; Mg# 34-48) whereas, in harzburgites, spinels are magnesio-chromites (Cr# 44-55; Mg# 56-62).
- The peridotites plots on the Olivine-Spinel Mantle array (OSMA, Fig 6. C) with dunites displaying very high degrees of partial melting ≥35% and harzburgites with comparatively 20-25% degrees of partial melting.
- Trace element modelling in clinopyroxenes suggests a lower 15-23% partial melting of a MORB source.
- Ol-Spl thermometry yields re-equilibration temperatures from 816ºC to 1046ºC for the peridotites.

Conclusions

- The peridotites display olivine textures typical of plastic deformation
- Dras harzburgites are highly depleted and display mixed geochemical affinities.
- Ultra-depleted dunites show possible interaction with boninite-like melts, possibly in a supra-subduction zone setting.

References

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Work in Progress, for any questions please contact shivanih823@gmail.com