Enrichment of Fluid-Mobile Elements in Forearc Mantle Peridotites in the Sulu UHP Belt, China

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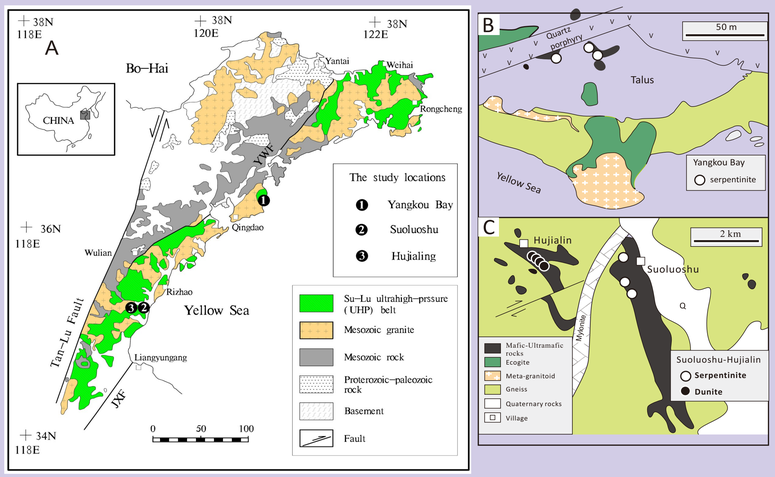
1. Introduction

The Sulu belt represents the product of the collision between the Yangtze craton and the North China craton (NCC). Subsequent subduction of the Yangtze continent below the NCC formed felsic gneisses metamorphosed under UHP conditions. Although the volume is minor, there are ultramafic bodies in close association with the UHP rocks. Ultramafic rocks in orogenic belts have provided information relevant to geodynamic and geochemical processes of subduction zones (e.g., Hattori & Guillot, 2003, 2007; Gorczyk et al., 2007; Saumur et al., 2010; Hattori et al., 2010).

This study presents the bulk and mineral chemistry of serpentinites from Yangkou Bay (YKB) and Suoluoshu (SLS) and dunites from Hujialin (HJL), and discusses (a) the origin of these ultramafic rocks, (b) the mechanism of their incorporation into granitic orthogneiss terranes, and (c) the enrichment mechanism of fluid–mobile elements in the studied rocks.

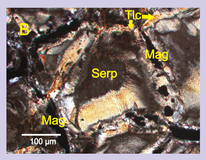
2. Locations and geological settings



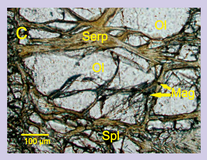
- (A) Study areas located in the centre of the Sulu UHP belt. (B) and (C) Simplified geological maps of Yangkou Bay (YKB) and Suoluoshu (SLS) -Hujialin (HJL) ultramafic bodies with the sampling locations.

3. Photomicrographs & back-scattered electron images

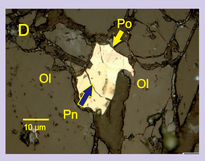
Olivine replaced by serpentine (Serp). Note dusty magnetite (Mag)



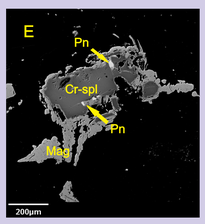
Serpentine with hourglass textures (SLS-1)



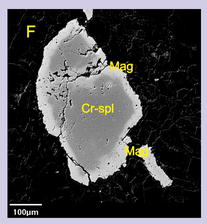
Olivine (Ol) altering to a mixture of Serp and Mag



Pentlandite (Pn) and pyrrhotite (Po) in dunite (HJL-1)

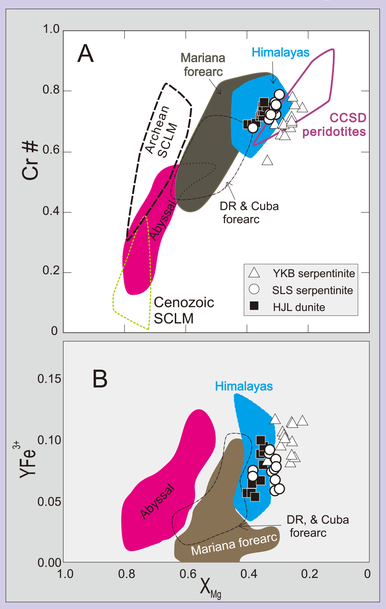


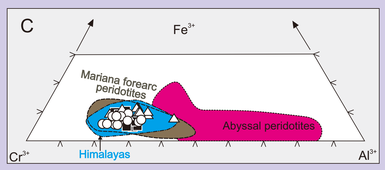
Cr-spinel (Spl) altering to magnetite (Mag). Note Pn with Mag



Cr-spl in dunite (HJL-2)

4. Mineral chemistry



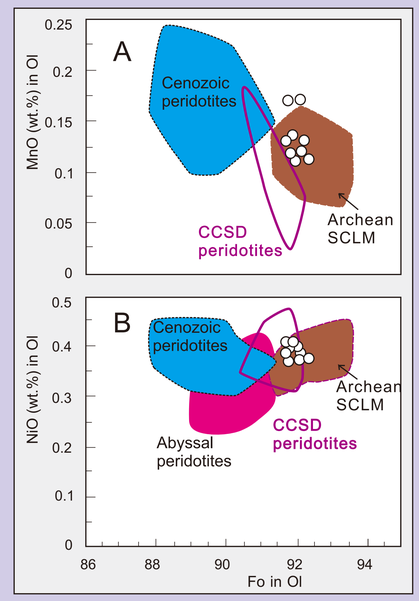


Our samples show higher Cr# than spinel in abyssal peridotites, Cenozoic SCLM, and Archean SCLM below the NCC. Instead, the data are similar to those in the forearc mantle peridotites, and peridotites intersected by China Continental Superdeep Drilling (CCSD), which was drilled in the Sulu belt.

The data suggests that the protoliths of our rock are refractory forearc peridotites developed below the margin of the NCC.

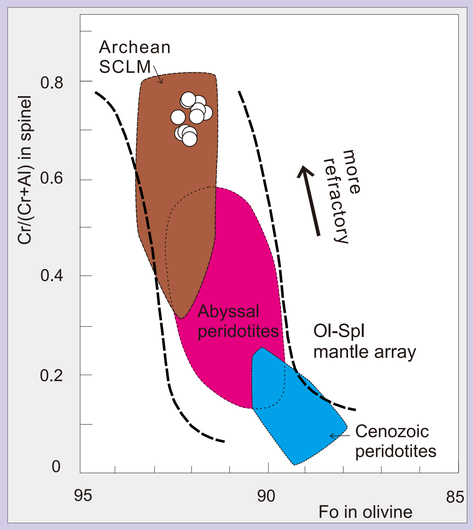
Cenozoic SCLM represent xenoliths in recent basaltic fields. Archean SCLM were xenoliths in Paleozoic kimberlites.

Data sources: Abyssal peridotite (Dick & Bullen, 1984), Mariana forearc (Ishii et al., 1992). Himalayas (Hattori & Guillot, 2007), Dominican Republic (DR) and Cuba forearc mantle (Saumur et al., 2010), Archean and Cenozoic SCLM (Zheng et al., 2001; 2006; Ying et al., 2006; Xu et al., 2010; Wang et al., 2012), CCSD peridotites (Zheng et al., 2006)



- Both Fo vs. NiO and Fo vs. MnO of olivine in our samples. Our olivine plots close to ancient SCLM and distinctly different from the fertile Cenozoic SCLM from the eastern NCC .
- The compositions of olivine grains suggest our dunites probably represent Archean lithospheric mantle underlying the SE margin of the NCC.

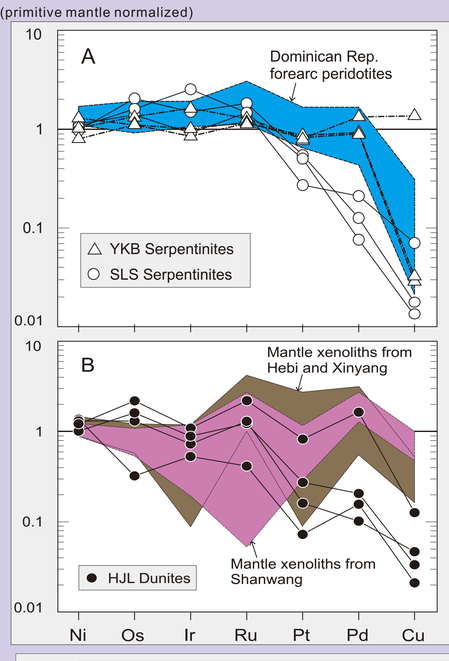
Data sources: abyssal peridotites from Dick (1989) and Sobolev et al. (2005).



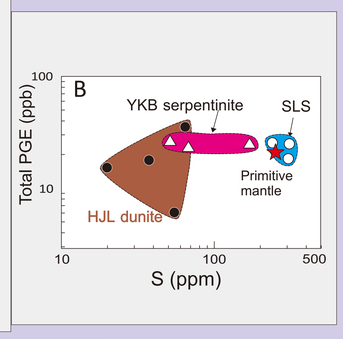
- HJL dunites plot in highly refractory field of the olivine-spinel mantle array (OSMA, Arai, 1994), similar to the field of ancient SCLM and CCSD peridotites from the eastern NCC and distinctly more refractory than fertile Cenozoic peridotites and abyssal peridotites, suggesting they probably represent the Archean lithospheric mantle.
- Data sources are same with the previous Figs.

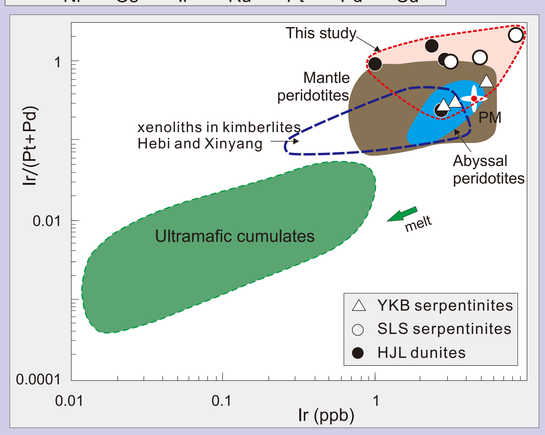
5. Platinum group elements

(primitive mantle normalized)



- high contents of Ir-type PGEs (Os, Ir, Ru) suggest that their protoliths are refractory mantle residues.
- High Ni and low Cu for HJL dunites confirm that they are also residual mantle peridotites after extensive partial melting.
- PGE contents are not correlated with those of S , suggesting that sulphides are not their host.

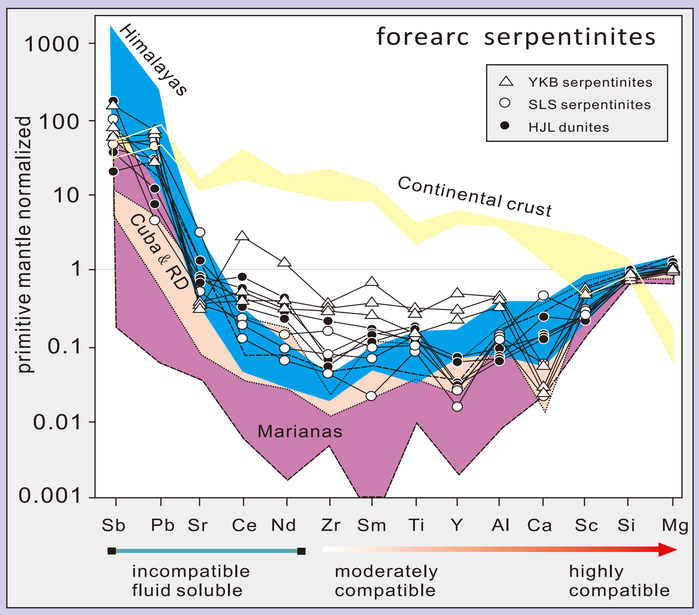




- Our samples plot in the field of mantle peridotites

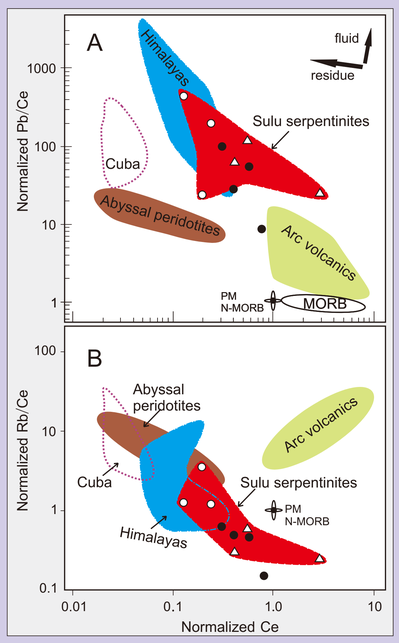
Date source: mantle xenoliths in Mesozoic volcanic rocks at Xinyang and Cenozoic basalts at Hebi (Zheng et al., 2005)

6. Fluid–mobile elements

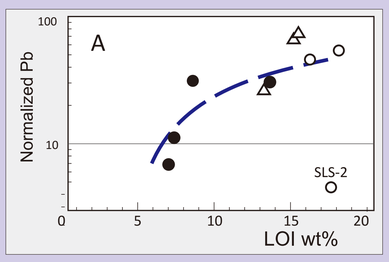


Our samples are highly enriched in fluid–mobile elements (such as, Sb, Pb, Sr, etc.). The degrees of enrichment is comparable to those for the Himalayan forearc serpentinites, and less than those for forearc serpentinites in the Cuba and Dominican Republic (DR) and Marianas.

Data sources: Himalayas (Hattori & Guillot, 2007), Cuba & Dominican Republic (Deschamps et al., 2012), Marianas (Savov et al., 2005).



- (A) The primitive mantle normalized Ce vs. Pb/Ce ratios. Our serpentinites show the enrichment of Pb, comparable to the Himalayan forearc mantle serpentinites. The enrichment is higher than that of forearc serpentinites from Cuba, suggesting that the degrees of enrichment are greater in continental subduction zones than oceanic subduction zones.
- (B) The ratios of Rb/Ce are comparable to or lower than those of abyssal peridotites, indicating that no esignificant enrichment of Rb in the samples. Considering that the studied samples are surrounded by granitic gneisses, the samples were enriched in other fluid-mobile elements before the exhumation with the gneisses



- (A). The positive correlation between the LOI values and Pb contents in bulk rocks, suggesting that the enrichment of fluid–mobile elements is a consequence of hydration and serpentinization of forearc mantle peridotities.

7. Conclusions

- 1). The ultramafic rocks including unhydrous dunites show highly refractory compositions, suggesting that they are residual mantle peridotites and exhumed from the forearc mantle below the margin of the NCC.
- 2). Our serpentinites and dunites show a strong enrichment of fluid–mobile elements (Sb, Pb, and Sr), that were most likely released from the subducted Yangtze craton following the collision with the NCC.
- 3). The degrees of enrichment in fluid-mobile elements in our samples are comparable to those in the Himalayan forearc mantle serpentinites, and much greater than those in the Marianan, Cuban and Dominican Republic forearc serpentinites. The differences reflect the compositions of subducted slabs; continental vs. oceanic.

8. Acknowledgements

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9. References

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