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The significance of zircon in oceanic mantle peridotites and chromitites

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Ophiolites are fragments of oceanic lithosphere emplaced on continental margins or in island arc and accretionary complexes. Thus, they should represent samples of oceanic crust and mantle uncontaminated by crustal minerals. Yet more than 15 ophiolites investigated by our research group, including those in the Yarlung Zangbo suture zone of Tibet, the Polar Urals of Russia, the Central Asian Orogenic Belt of North China and the Tethyan belt of the eastern Mediterranean region, contain abundant crustal minerals, most notably zircon, along with ultrahigh pressure (UHP) and highly reduced minerals. The investigated ophiolites range in age from early-middle Paleozoic to Cretaceous and include those hosting either high-Cr or high-Al chromitites. The zircons, which occur in both mantle peridotites and their associated podiform chromites, range from sparse to abundant. They are mostly <200 μm in size, vary in shape from rounded or irregular to euhedral and display a range of complex textures. All of the zircon grains analysed thus far have trace element compositions indicating a continental protolith and they contain inclusions of common crystal minerals, including quartz, plagioclase, K-feldspar, amphibole, muscovite, biotite, apatite and rutile. Ages of the analysed zircons range from Archean to Cretaceous. In a few cases (Sartohay ophiolite of China and Ray-Iz ophiolite of Russia), the ages of some old zircons have been modified by hydrothermal activity. The widespread occurrence of zircon and other crustal minerals in oceanic mantle rocks can best be explained by subduction of continental rocks or continentally derived, clastic sediments into the upper mantle or mantle transition zone where they are mixed with UHP and highly reduced phases formed at greater depths. Preservation of the crustal minerals in the upper mantle appears to reflect their incorporation into crystallizing magnesiochromite grains, which can occur at any depth above the transition zone. Recycling of upper mantle rocks containing such minerals could produce widespread contamination of the upper mantle. Such a process may help to explain the presence of Proterozoic, Paleozoic and Mesozoic zircon in gabbros on the Mid-Atlantic Ridge [1,2].

References :

[1] Pilot et al. (1998) Nature 393: 676-679

[2] Sharkov et al. (2004) Dokl. Earth Sci, 397: 654–657.