# Permian-Triassic komatiites and their Os isotopic characteristics in northwestern Vietnam

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Among the rare examples of Phanerozoic komatiites are those found in the Song Da zone, NW Vietnam. These komatiites were erupted through continental crust as they belong to the SE extension of the Permian-Triassic Emeishan CFB province. They provide a good opportunity to study the source characteristics of starting plume magmas in a LIP. Erupted on late-Permian carbonate rocks, the komatiitic rocks are interbedded with low-Ti olivine basalts. Basaltic komatiites display pyroxene spinifex textures, while more magnesian rocks (MgO up to 32 wt.%) are porphyritic, containing a single, cognate population of euhedral to elongated olivine phenocrysts with Fo up to 93.0%. This suggests a highly magnesian parental magma with 22-23 wt.% MgO. In terms of major elements, the komatiites are similar to the Gorgona komatiites, and they are depleted in LREE ($Ce_N/Yb_N$ 0.30-0.62) and have unfractionated HREE. The associated low-Ti basalts have flat or LREE-enriched REE patterns.

Komatiitic rocks have high Os concentrations (up to 7.0 ppb) and low Re/Os ratios and define an isochron with an age of 269±24 Ma and an initial $^{188}Os/^{187}Os$ ratio of 0.12509 ±0.00050 ($\gamma_{Os}$ = -0.1±0.4). These high-Mg magmas have undergone no or insignificant crustal contamination and closely represent mantle-derived compositions. On the other hand, the associated olivine basalts yielded more radiogenic $\gamma_{Os}$ values ($\geq$15) and were either crustally contaminated or derived from a different, more radiogenic source. The mantle source of the Song Da komatiites was incompatible-element depleted but had chondritic time integrated Re/Os. They provide further evidence that high-temperature partial melts have tapped depleted mantle plume sources, probably from the lower mantle, not only in the Archean but also relatively recently and not only beneath the oceanic but also continental lithosphere.

# Hydrothermal zircon: A case study of an Alpine site

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Large zircons from a mineral collecting site in the Alps (Pfitsch Valley, Italy) show mineralogical and textural features that clearly indicate a hydrothermal origin and thus are ideally suited to characterise this genetically distinct variety of zircon and the conditions of hydrothermal zircon formation.

The zircons occur in metarodingite dikes in serpentinites associated with Permo- Mesozoic ophiolites and calcschists of the upper schist cover of the Tauern Window. At the sampling site, the Alpine regional metamorphism reached lowermost amphibolite grade. A part of the serpentinites and metarodingites underwent late- to post - metamorphic hydrothermal alteration by a CO2 -rich fluid transforming antigorite schist into a talc-magnesite rock.

Hydrothermal zircons in veins cutting the metarodingites and their blackwalls occur together with diopside needles, chlorite, titanite, magnetite and a late calcite filling. Hydrothermal zircons also occur in a metasomatised metarodingite that was completely transformed to dolomite, ilmenite and chlorite. Some of the zircons show nearly perfect prismatic crystals exhibiting (110) and (101) faces only. This morphological type otherwise occurs in hydrous granites and pegmatites.

The zircons clearly do not represent remnants from the wall rock for the following reasons: a) Zircons in ultramafic and mafic rocks usually crystallised late - magmatically and show features of impeded growth. By contrast many of the vein zircons show one perfectly crystallised pyramidal termination facing into the vein and an opposite end frequently intergrown with the vein wall. b) They contain inclusions of hydrothermal vein phases such as diopside and chlorite. c) Their U-Pb age of 36 - 37 Ma is distinctly younger than the minimum Mesozoic intrusion age of the mafic dikes inferred from geological relations. d) Some of zircons contain primary aqueous fluid inclusion.

The presence of zirconolite and baddeleyite in unaltered metarodingites strongly suggests that these oxides were the source of Zr for the hydrothermal zircons. Omnipresent carbonates in the alteration zones indicate that a $CO^{2-}$ or carbonate - rich late-metamorphic fluid precipitated the hydrothermal zircons. The strongly corrosive nature of the reacting fluid is evidenced by the fact that in the most intensely altered zone even hydrothermal zircons show signs of late corrosion.