# Composition of serpentine after olivine and orthopyroxene: Serpentinized peridotites of Nain ophiolite (Isfahan Province, Iran)

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## Introduction

The Naein ophiolite is one of the most complete ophiolitic suits at the East of Central-East Iranian Microcontinent - ophiolitic belt and it comprises a high proportion of serpentinized mantle peridotites [1]. As a possible alteration product of Nain mantle peridotites, serpentine constructed the veinlets and the mesh texture, characterized with a pale green-white chalky feature. The fibrous serpentine filled the cracks and veinlets are crossing the mesh texture and this indicates their former formation.

## Raman Spectrometry and Microprobe Data

Raman Spectrometry of the serpentine suggests that the mesh texture is made of lizardite and the rock veinlets are filled by chrysotile. Based on major element data, lizardite is $Mg_{3.00}$ $Fe_{0.31}$ $Ni_{0.01}$ $Si_{1.84}$, with $Al_2O_3$= 0.00 wt%, Mg#=0.91, Cr#=0.00 in composition and chrysotile is $Mg_{2.14}$ $Fe_{0.10}$ $Al_{0.23}$ $Cr_{0.02}$ $Si_{2.18}$, with $Al_2O_3$= 2.84-5.97 wt%, Mg#=0.96, Cr#=0.10.

## Disccusion of Results

Lizardite is characterized with higher Mg, Fe and Ni in while chrysotile is higher in $Al_2O_3$ and Cr#. [2] suggested that serpentine after orthopyroxene (bastite) are generally low in MgO (~ 34–37 wt.%), but have silica similar to serpentine after olivine (38–42 wt%). MgO of the studied chrysotile (~ 30-32 wt%), formed after orthopyroxene are generally higher than MgO of lizardite (~ 29 wt%), formed after olivine (i.e. lizardite), but the silica has a similar range (~ 43-54 wt%) in chrysotile and lizardite. The low Mg and high Cr and Al of chrysotile is a consequence of the composition of the original orthopyroxene (e.g., [3]; [4], [2]). Therefore, Al-rich serpentine of chrysotile is found in orthopyroxene bastite with lower MgO and FeO contents, and higher $Al_2O_3$ and $Cr_2O_3$ concentrations, while the lizardite is the serpentinization product of olivine.

[1] Shirdashtzadeh *et al*. (2013) Lithos (Submitted). [2] Shervais *et al*. (2005) Inter Geol Rev **47**, 1-23. [3] Dungan (1979) Can Min **17**, 77 l-784. [4] Wicks & Plant (1979) Can Min **17**, 785-830.

# Water content of inclusions in superdeep diamonds

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The water content of the mantle strongly influences mantle convection and partial melting. Previously, direct measurements of mantle water content have been limited to peridotites or inferred from basalts. Superdeep or sublithospheric diamonds from the transition zone and lower mantle carry ultra-high pressure silicate and oxide micro-inclusions that provide an unparalleled opportunity to directly sample the composition, mineralogy and water content of deep mantle minerals.

We measured mineral inclusions in Type II (<20 ppm N) diamonds from the 93 Myr old Collier 4 kimberlite pipe in the Juina field of Brazil for their water content with the DTM NanoSIMS 50L. Studies of these diamonds showed complex growth structures, diverse inclusion assemblages, and heterogeneous C isotopic compositions (-5‰ to -25‰) interpreted as being due to subducted components entrained in the Trinidade plume [1]. Simultaneous scanning ion imaging of $^{12}C$, $^{16}O^1H$, $^{18}O$, $^{19}F$, $^{30}Si$ and $^{56}Fe$ was employed and data reduced using the *L'image* (© LR Nittler, DTM) image-processing software. $H_2O$ contents vary from nominally-anhydrous phases such as majorite (30 ppm, J9), walstromite after CaSi-perovskite (74 ppm, J14), and Mg-Al spinel (245 ppm, J2) to more water-rich phases such as Mg-pyroxene (former MgSi-perovskite, 2600 ppm, J2), $Fo_{91}$ olivine (2300 ppm, J20) and K-feldspar (7800 ppm, J2). Mg-silicate phases along an internal fracture (J9) have 2.3 to 3.8 wt% $H_2O$ and may be epigenetic or compromised.

Inferences on the mineralogy and $H_2O$ contents of the inclusions at the time of trapping depend on identification of retrograde phases, final retrograde pressure, and $H_2O$ storage capacity of the retrograde mineral assemblages. Correspondence of lowest measured water with the most anhydrous phases suggests some retention of original water content, however. Forsteritic olivine with 2300 ppm $H_2O$, and aluminous Mg-pyroxene with 2600 ppm $H_2O$, are consistent with $H_2O$ saturation at pressures ≥ 7 GPa [2] and represent lower limits on the original $H_2O$ content of these inclusions if their trapping depths were greater than 200 km.

[1] Bulanova *et al*. (2010) *Cont. Min. Petrol*. 160 489-510. [2] Hauri *et al*. (2006) *Earth Planet. Sci. Lett*. 248, 715-734.


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