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A new tool to probe lithosphere evolution: OH signatures of pyroxenes

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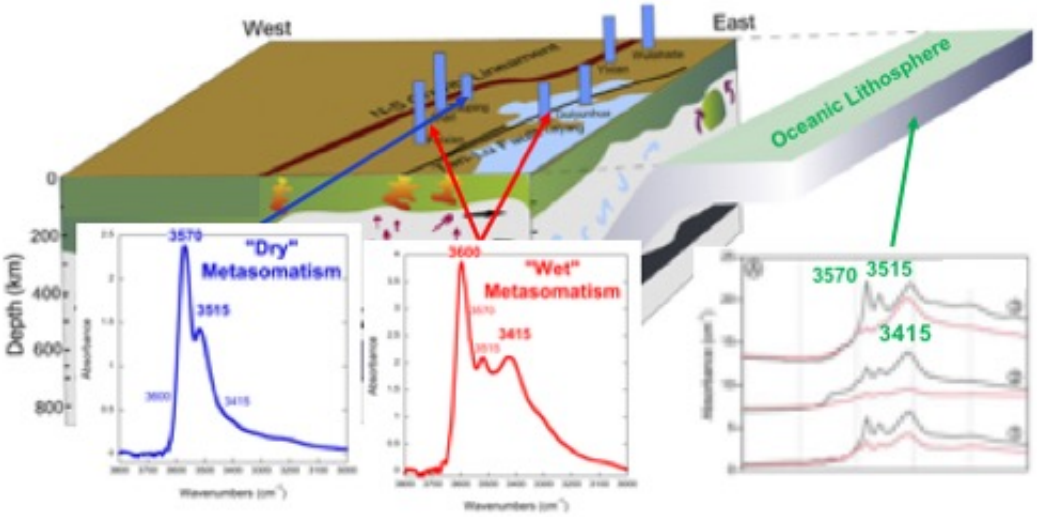
Four OH stretching bands in the frequency range 3300 – 3700 cm^{-1} dominate the infrared spectra of lithospheric pyroxenes. Depending on their metasomatic history or geodynamic origin, they have characteristic OH signatures. Pyroxenes from continental lithosphere that undergone “wet” metasomatism have distinct signature of those having undergone “dry” metasomatism. Pyroxenes from oceanic lithosphere have yet a third type of signature. Our most recent analyses of xenoliths and a critical review of the literature show that the phenomenon is widely distributed among continents and oceans. The phenomenon affects simultaneously opx and cpx from the same rock and various lithologies: peridotites, pyroxenites and granulites. In continental lithosphere, pyroxenes affected by “wet” metasomatism are dominated by OH bands at 3600 and 3415 cm^{-1} for opx and 3635 and 3445 cm^{-1} for cpx . Whereas pyroxenes affected by “dry” metasomatism are dominated by OH bands at 3570 and 3515 cm^{-1} for opx and 3595 and 3515 cm^{-1} for cpx. Opxs from oceanic lithosphere have OH spectra dominated by the band at 3415 cm^{-1}, and with a smaller by bands at 3520 and 3570 cm^{-1} (Fig. 1).

In all these observations it was not possible to correlate the signatures with a specific major, minor or trace element. Therefore, the exact nature of the observed signatures remains unidentified. Notwithstanding, these OH signatures are representative of specific lithospheric events and offer a potential new benchmark for the study of lithospheric processes.

Fig.1 : Schematic diagram showing the 3 types of signatures for opx. Spectra from opxs in oceanic lithosphere are from Gose, J., Schmadicke, E. and Beran A.: Geology, 37, 543-546, 2009. Drawing of subduction is from WangZ-Z., Liu,J., Xia, Q-K., Hao Y_T. and Wang Q-Y.: Lithos, 360-361, 2020.


West
East
Oceanic Lithosphere
Depth (km)
0
200
400
600
800
3570
"Dry"
Metasomatism
3515
3600
3415
Absorbance
Wavenumbers (cm-1)
3600
"Wet"
Metasomatism
3570
3515
3415
Absorbance
Wavenumbers (cm-1)
3570 3515
3415