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The dry but "Wet" mantle

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The presence of water in the mantle minerals has a disproportionately large effect on the physical and thermodynamic properties of the upper mantle. Ideas about water storage in the mantle have evolved significantly during the last two decades. Traditionally the term “wet mantle” was intrinsically linked to modally metasomatized peridotites containing amphibole and/or mica. However, a compelling body of works has shown that olivine and pyroxenes, the dominant mantle minerals, originally considered to be anhydrous “dry” minerals, can in fact contain trace amounts of H and were thus called Nominally Anhydrous Minerals (NAMs). Therefore, water content in the mantle has been almost exclusively considered through the NAM's water budget, pushing hydrous minerals to the back burner.

Similarly, the contribution of the elusive grain boundary and interstitial components (GBIC), the “stuff” between the silicate grains, is often overlooked. GBIC has been recurrently proposed as a likely major reservoir for incompatible trace elements such as LREE, U, Th and Ba. As H is also an incompatible element, GBIC could therefore play a key role in H storage in the mantle.

In this study, we investigate water content and distribution in 22 peridotite xenoliths (spinel facies) hosted in alkali basalts from worldwide occurrences. To assess water distribution and content, we combine *in-situ* analyses by FTIR (Fourier Transform Infra-Red Spectroscopy) analysis on NAMs with thermal resolved simultaneous analysis of emitted gas (STA-QMS) of whole-rock and mineral fractions, including amphibole.

This unique hybrid data set sheds some novel light on the distribution of water throughout mantle bulk-rock assemblages and reveals counter-intuitive relationships between NAMs, hydrous phases and GBIC. These include:(i) hydrogen concentration in NAMs is independent of the occurrence and volumetric abundance of hydrous phase;(ii) a large volume of “water” is stored in GBIC; (iii) metasomatic phases compete with the GBIC for the storage of volatile elements. In summary, our results indicate that water abundance in the sub-continental lithospheric mantle has been significantly underestimated and that we need to consider a larger picture than NAMs for a robust assessment of the budget and behaviour of water and, likely other volatile elements, in the Earth's mantle.