

Fate of nutrients in the fresh-saline water interface in coastal aquifers

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The fresh-saline water interface (FSI) is the transition zone between fresh and saline groundwater in coastal aquifers. Major ions composition indicate if the FSI deviates from conservative mixing between fresh and saline end-members, mainly attributed to cation exchange.

This study aims to quantify the changes in nutrient concentrations (NH_4^+ , NO_3^- , NO_2^- , PO_4^{3-} and $\text{Si}(\text{OH})_4$) across the FSI at the Israeli coastal aquifer due to freshening and salinization processes. In addition to field sampling in boreholes at the coastal aquifer, experimental studies were conducted to simulate salinization and freshening events using sediment columns and a flow-through system.

The field results show that the FSI acts as a redoxcline. The oxidized fresh groundwater zone is characterized by relatively high NO_3^- and low NH_4^+ and NO_2^- concentrations, while the saline groundwater is almost anoxic with high NH_4^+ and low NO_3^- and NO_2^- . Within the FSI NO_2^- was enriched.

During the experiments the nutrients behavior was not conservative as well. This was attributed to denitrification, adsorption/desorption and dissolution processes, similar to the field observations.

$\delta^{18}\text{O}$ zoning in eclogite garnet

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Metamorphic garnets record history and can preserve evidence, through chemical zoning, of chemical changes and fluid interactions. O isotope ratios in minerals are valuable as monitors of fluid interactions. Secondary Ion Mass Spectrometry (SIMS) allows the measurement of $\delta^{18}\text{O}$ at 10 μm scale in garnet with a precision of $\pm 0.3\text{‰}$ (2sd) [1].

Nine garnets from eight different eclogite localities across Europe were analyzed for $\delta^{18}\text{O}$ zoning. Samples are from the Saxothuringian and Moldanubian Zones of the Variscan Bohemian Massif; Trescolmen, Alps, and the Scandian-age Nordfjord region, Norway. Analyzed by laser fluoination, eight garnets had bulk $\delta^{18}\text{O}$ values between -0.41 and 3.75‰ , and the ninth, 8.18‰ [2].

This first detailed study of $\delta^{18}\text{O}$ zoning in eclogite garnet reveals a common pattern: low $\delta^{18}\text{O}$ in the core with higher $\delta^{18}\text{O}$ rims (Figure). Seven out of nine garnets analyzed have this type of zoning, independent of garnet size, geological setting, peak metamorphic conditions, age, and garnet composition.

Our results are consistent with an inherited low $\delta^{18}\text{O}$ core derived from hydrothermally altered mafic protoliths formed at an oceanic spreading center. Due to small oxygen fractionations at high T between garnet and other minerals [3], and the refractory nature of garnet, we conclude that the increase of $\delta^{18}\text{O}$ toward the rims represents interaction with a high $\delta^{18}\text{O}$ reservoir at high pressures.

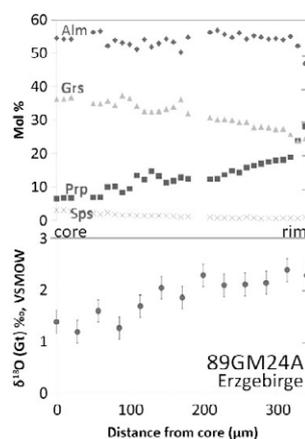


Figure: $\delta^{18}\text{O}$ and major element zoning from core to rim in garnet from the Erzgebirge[4].

- [1] Page *et al.* (2010) *Chem. Geol.* **270**, 9–19. [2] Wiesli (2002) *Geochem. ecl. & metapel. Adula Nappe, Central Alps, Switzerland. PhD thesis*, University of Tennessee at Knoxville. [3] Eiler (2001) *Rev. Min & Geochem* **43**, 319–359. [4] Klápová *et al.* (1998) *J. Geol. Soc.* **155**, 567–583.