Comparison of the development in melt compositions in the Faroe Islands and East Greenland during continental breakup in the Paleogene

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The upper part of the Faroe plateau lavas erupted during continental rifting and can be correlated with East Greenland counterparts of the Paloegene North Atlantic Igneous Province (Søager & Holm, this conf.). Low-Ti lavas with typically La/Sm_{cho} = 0.3-0.4 have fractionated Dy/Yb_{cho} up to 1.25 which require substantial melting with residual garnet and thus a relatively hot source. Compared to late low-Ti lavas, the early tend to have more radiogenic Pb and occur in the northeastern parts. There is also a)7/4 decrease from 0 to -3 with time, while positive)8/4 show a rough increase with time. The low-Ti basalts with the most radiogenic Pb show a marginal overlap with Icelandic rocks. Dy/Yb has a negative correlation with $^{206}Pb/^{204}Pb$ and on formation level there is an increase in $^{206}Pb/^{204}Pb$ with time.

While the low-Ti basalts seem to be similar on both sides of the rift, the high-Ti basalts in the Faroes indicate decreasing depth of melting throughout the development, whereas the contemporaneous RFF in East Greenland has melts derived at high pressure. However, as in East Greenland, there is a change with time from IE2 to IE1 (Thirlwall & al., 2004) end-member composition. The increasing fraction of high-Ti basalts to the south could be caused by lateral variation in the mantle plume. Relatively low Dy/Yb indicates lithospheric thinning to have continued at the Faroes in contrast to East Greenland. A MORB-type source dominates the early low-Ti basalts, while NAEM (Ellam & Stuart, 2000) mantle composition is more important in the later development. This depleted two-component source is proposed to be part of the early Iceland plume and contributed much more in Faroes than in East Greenland.

References

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Bubble gas-exchange in an artificially aerated lake traced using noble gases

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The concentrations of dissolved atmospheric noble gases in open waters generally correspond to the equilibrium concentrations determined by temperature and salinity during atmospheric gas exchange. As noble gases are chemically inert, only physical processes may change the noble-gas abundance and hence are responsible for deviations from the initial equilibrium. Gas bubbles that are released at the bottom of a lake will affect the concentrations of dissolved gases in the water column, as the bubbles strip gases from the surrounding water and dissolve simultaneously during their ascent. The effect of these secondary gas exchange processes on the concentrations of dissolved gases varies depending on the solubility and diffusivity of the respective gas and on the initial gas concentrations in the bubbles.

We measured dissolved noble gas concentrations in Lake Hallwil (Switzerland), a small eutrophic lake, to trace the effects of gas release from an aeration system. This installation prevents anoxia in the deep water by the injection of oxygen-rich gas bubbles at the bottom of the lake. Noble gases in both the aeration gas and dissolved in the water of the lake were analyzed.

The measurements show that noble gases in the injected gas are strongly fractionated with respect to air. He, Ne and Ar are enriched, whereas Kr and Xe are virtually absent. Noble gases dissolved in the lake water show corresponding deviations from the atmospheric equilibrium concentrations. Deep-water samples taken at three different locations in the lake are supersaturated in He, Ne and Ar. The magnitude of the enrichment decreases with increasing distance from the bubble source. The observed noble gas supersaturations were also found to vary according to the operation mode of the aeration system, with higher gas flow leading to stronger noble gas enrichment. In contrast, only minor changes of the dissolved oxygen concentrations could be detected due to fast oxygen consumption.

In conclusion, the example of Lake Hallwil demonstrates that gas exchange with injected bubbles affects the noble gas abundance in the water body. Noble gas analyses allow quantifying the effectiveness of the aeration system, i.e. noble gas enrichments can be interpreted as a measure for the oxygen transfer to the lake water. Note that these findings may also help to understand natural systems like gas seeps in lakes and oceans.