# Nucleogenic neon isotopes as an extension to Ar-Ar dating

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In addition to the $^{37}Ar$, $^{38}Ar$ and $^{39}Ar$ that are produced from Ca, Cl and K, respectively, Ne isotopes are also formed during neutron irradiation. Mineral and glass samples of known composition have been irradiated to determine the important nucleogenic Ne isotopes produced from F, Na and Mg. The relevant reactions are given in [1], but the key production is $^{20}Ne$ from F, $^{21}Ne$ and $^{22}Ne$ from Mg, and $^{20}Ne$ plus a small amount of $^{22}Ne$ from Na. The production of $^{20}Ne$ from F is a thermal neutron reaction and it will therefore be greatly reduced if Cd shielding is used. $^{22}Ne$ from Na requires very high incident energy and this reaction has a very low cross section.

There are only 3 isotopes and 4 nucleogenic plus air end member isotopic compositions and it is therefore not possible to uniquely resolve these nucleogenic sources along with atmospheric Ne. Fortunately, most unirradiated minerals analyzed have had extremely low and usually negligible levels of atmospheric Ne. A maximal correction for atmospheric Ne can be done assuming an atmospheric $^{20}Ne/^{36}Ar$ ratio.

New data suggest that, at least for glass and feldspar samples, Ne isotopes diffuse at very different rates from Ar isotopes and even normal bakeout temperatures can cause the loss of most or all of the nucleogenic $^{22}Ne$ in a Na-rich sample. This severely limits the technique's usefulness for the analysis of feldspars i.e. for distinguishing albite from orthoclase or plagioclase. However, whole rock volcanic and amphibole mineral samples show that Mg-rich minerals can retain their Ne isotopes until very high temperatures and the technique may be useful in these circumstances to unravel the effects of complex mineral assemblages or alteration products on age spectra.

Measuring Ne isotopes along with Ar isotopes is challenging, requiring extra time and cryo-separation of the two species. Examples of a variety of Ne-enhanced argon age spectra will be shown.

[1] Hall (2007) *EOS Trans. AGU* **88**(52) V32B-04.

# Generation of porphyritic rift zone basalts in Iceland – Evidence from the Thjorsa lava

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The Thjorsa lava is a voluminous tholeiite fissure lava flow originating within the Bardarbunga volcanic system of the Eastern Rift Zone, Iceland. The lava has a high content of xenocrysts of plagioclase and minor olivine where individual plagioclase crystals have high An uniform core with a thin rim of plagioclase with a significantly lower An composition, identical to the groundmass plagioclase. The olivine also has high Fo cores but normal zoning.

In this study, elemental and isotope (Sr, Nd, and Pb) analyses were carried out on a suite of groundmass samples, and the $^{87}Sr/^{86}Sr$ ratio in plagioclase/groundmass pairs. In the context of our isotopic data for Icelandic volcanic products, the host lava groundmass (i.e. the liquid phase) has a restricted variation in elemental and isotopic composition (Sr, Nd, and Pb). The plagioclase separates show a range of $^{87}Sr/^{86}Sr$ isotopic values, but with hardly any overlap with the groundmass. The large range of the isotope signature of the plagioclase xenocrysts indicates that they are formed by multiple intrusion events. The plagioclases are therefore xenocrysts, and significantly more isotopically primitive than the host groundmass, and derived from a different mantle source.

After segregation, the almost isotopically homogeneous liquid entered the gabbroic lower crust and caused disintegration and melting of its mineral assemblages. The disintegration process caused digestion of cpx, which left a chemical signature reflected in the correlation between cpx bearing elements (Cr/Y, Sc/Y) and isotopic ratios of Sr, Nd and Pb in the most porphyritic groundmass samples. Relics of Cr-rich cpx microliths and Cr-diopside xenoliths found throughout the lava flow are assumed to be the leftovers and examples of the digested cpx.

The normal zoning pattern of the olivine xenocrysts was used to estimate the time the olivine was in contact with the host magma, assuming the zoning is due to diffusion, resulting in estimates of only a few months. The Thjorsa lava can therefore be seen as a remarkable example of a large-scale remobilization of crustal cumulates only shortly before, or during eruption.