Reactivity of a ryolitic glass

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The dissolution mechanism of basaltic glass had been defined by Oelkers and Gìslason (2001), but very little is know about acidic glass such as ryolitic glass.

Ryolytic glass was processed in a mixed flow reactor Parr[TM]. As a proxy for the dissolution rate we have used the outlet concentration of Si and Al. The conditions of the experiment was from 40 to 200°C and a pH from 2 to 10,6.

The dissolution mechanism of the basaltic glass is defined by the following equation (1):

$$r_+ = A e^{-\left(\frac{E_A}{RT}\right)} \left(\frac{a_{H^+}^3}{a_{Al^{3+}}}\right)^{1/n} \qquad (1)$$

With A a constant, Ea the activation energy, R the perfect gas constant , T the temperature and ai the activity of i.

Assuming that the dissolution mechanism is the same for both glasses we determined each parameter separately and obtained the following equation:

$$r_+ = 0.031 . \exp\left(\frac{-77300}{RT}\right) . \left[\frac{a_{H^+}^3}{a_{Al}^{3+}}\right]^{0.18} \qquad (2)$$

The good fit of the computed (eq.2) and predicted data (fig.1) shows that this equation can predict the dissolution rate of the rhyolitic glasses implying that the same mechanism.
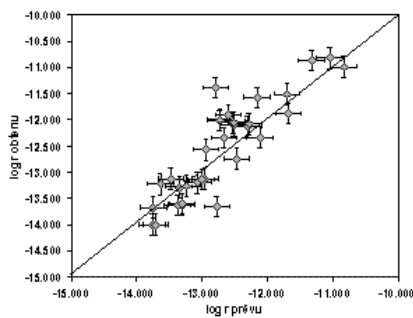

Figure. 1: Comparison between the predicted dissolution rate and the rate measured.

Because the dissolution mechanism for the rhyolitic and basaltic glass is the same it is possible to develop a general equation for the dissolution of natural glass.

References

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Sr-Nd isotope data on diorite-trondhjemite associations from the central Norwegian Caledonides

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The Trondheim Nappe Complex (TNC) comprises several slightly metamorphosed ca. 435 Ma old leucocratic igneous bodies and dykes. They often have 'trondhjemitic' affinity, but not all the leucocratic rocks share the typical characteristics of trondhjemites, such as a high Na/K ratio and strongly depleted heavy REE. The trondhjemitic rocks in the TNC are generally associated with dioritic rocks having mafic to intermediate composition. Since it seems unlikely that this close association in the field is fortuitous, it should be considered a significant pointer to the petrogenesis of the trondhjemitic series. Interest in trondhjemites has been revived because of the similarities to Cenozoic felsic rocks called adakites, which are thought to be melting products of the young, still hot subducted slab. If a similar origin applies to the Phanerozoic and older trondhjemitic rocks, it could help to understand the evolution of subduction-related petrogenetic processes throughout Earth's history.

A detailed petrographical and geochemical investigation of these TNC felsic trondhjemitic series and associated mafic/intermediate rocks is in progress with the aim to reveal the petrogenetic relationship between the two series. Most of the leucocratic rocks show the pronounced depletion of heavy REE, which is generally attributed to partial melting of eclogitic parent rocks. The absence of negative Eu-anomalies in the REE patterns pecludes derivation of trondhjemitic rocks from protracted fractional crystallisation of melts of intermediate composition. The associated mafic to intermediate rocks have REE patterns that are not depleted in heavy REE. They show geochemical characteristics typical of Cenozoïc subduction related calc-alkaline series.

In contrast to the differences in major and trace element composition the trondhjemitic and associated mafic rocks have very similar isotopic composition of Sr and Nd. The 'initial' (i.e. at a nominal 435 Ma age) $^{87}Sr/^{86}Sr$ ratios and εNd values of the greater part of the analyzed samples define an array between $^{87}Sr/^{86}Sr$= 0.703; εNd= +6 and $^{87}Sr/^{86}Sr$= 0.706; εNd= -4. The positive εNd data suggest that a depleted mantle or mantle-derived end-member was involved in the petrogenesis, while the higher $^{87}Sr/^{86}Sr$ and negative εNd values seem to imply an additional enriched crustal component. Formation of the trondhjemitic rocks by melting of old crustal material appears improbable. Though it is premature to decide on the most plausible petrogenetic model for the TNC trondhjemites, a viable option is remelting of lower crustal plutonic equivalents of the mafic rocks that have been emplaced together with the trondhjemites at higher crustal levels.