

A new Early Carboniferous alkaline province in the crystalline basement of NE Poland

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Three alkaline magmatic complexes were discovered by deep drilling in northeastern Poland: the Tajno alkaline-carbonatite complex, the Elk alkaline-syenite massif and the Pisz gabbro-syenite intrusion. The complexes occur in a narrow E-W band along the southern rim of the Mazury Complex, NE Poland. An earlier Rb-Sr whole rock isochron for Elk syenites suggested an age of 355 ± 4 Ma. K-Ar results estimate a Late Paleozoic age for the Pisz and Tajno complexes. Here we present new U-Pb zircon (SHRIMP, TIMS) and Re-Os sulphide (NTIMS) geochronology. The new U-Pb results are very consistent: 348 ± 8 Ma for Elk, 346 ± 5 Ma for Pisz (SHRIMP) and 348 ± 15 Ma (TIMS) for Tajno. These ages point to an Early Carboniferous emplacement for platform mafic-alkaline magmatic activity in NE Poland. Re-Os data for a sulfide sample (pyrrhotite) from the Tajno carbonatite yield an age of 348 ± 2 Ma, calculated using an initial Os ratio of 0.2. The sample is LLHR (low level-highly radiogenic [1] with $^{187}\text{Re}/^{188}\text{Os} = 2466 \pm 5$); thus, selection of the initial Os has minimal effect on the age calculation. Sr-Nd isotope signatures for the Tajno silicate rocks and carbonatites, with I_{Sr} (348 Ma) of 0.7033 to 0.7042 and ϵ_{Nd} (348 Ma) of +3.6 to +1.4, suggest possible involvement of two contrasting mantle components, DMM and EM1, in proportions of 95:5. The alkaline-ultramafic Tajno complex together with the Elk and Pisz intrusions are located on the extension of the Upper Devonian Pripyat-Dnieper-Donets (PDD) paleorift and may be comparable to the Late Devonian Kola Alkaline Carbonatite Province (KACP) and to the volcanic diatremes of the northern wing of PDD.

[1] Stein *et al.* (2000) *Economic Geology* **95**, 1657–1671.

Calcite growth rate and solution composition

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The calcium to carbonate ratio of aqueous environments from which calcite crystals form can vary widely. For example, the free dissolved calcium to carbonate ratio in sea water is around 250 and in groundwater around 430, while during intracellular biomineralisation the ratio is expected to be much smaller. Previous work has shown that the calcium to carbonate ratio (solution stoichiometry) affects the rate of crystal growth and dissolution. Nevertheless, models for crystal growth kinetics and dissolution generally ignore this effect. Here we present a model for calcite growth rate that takes solution stoichiometry and pH into account.

The mechanistic growth model combines a surface structural model for divalent metal carbonates [1] with a growth model for binary symmetrical electrolyte crystals such as NaCl [2]. The latter model is extended to account for the different surface reactions taking place during growth. The resulting model describes step movement and kink formation rates and calcite growth rate depending on solution stoichiometry. Because bicarbonate is included in the model, pH is explicitly defined as well. The development of the mechanistic growth model is guided by the experimental data of Nehrke *et al.* [3] and further validated with previously published experimental data sets for calcite growth rates obtained over a wide range of solution composition in systems closed and open to the atmosphere.

[1] Wolthers, Charlet & Van Cappellen P. (2008) *American Journal of Science* **308**, 905–941. [2] Zhang & Nancollas (1998) *Journal of Colloid & Interface Science* **200**, 131–145. [3] Nehrke, Reichart, Van Cappellen, Meile & Bijma (2007) *Geochimica Cosmochimica Acta* **71**, 2240–2249.