U-Pb zircon ages from granites in the Iapetus Suture Zone in Ireland and the Isle of Man

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Late Caledonian syn- to post-orogenic granites located in the Iapetus Suture Zone (ISZ) in Ireland and Britain have been related to A-type subduction and possible slab breakoff following the Laurentia-Avalonian collision. Lack of reliable age data (especially in Ireland) has inhibited petrogenetic investigations of these rocks. Hence, ion microprobe U-Pb analyses on zircons from Irish and Isle of Man granites have been undertaken to provide better constraints on this episode of the Caledonian orogeny.

Three stages of granitic magmatism (c. 428, 417, 397 Ma) are indicated by U-Pb dating of oscillatory-zoned magmatic zircons. The Crossdoney, Kentstown, Drogheda, Ballynamuddagh and Dhoon granites together with a rhyolite from Glenamaddy have yielded U-Pb concordia ages, interpreted as intrusion-ages, between 419.1±2.4 Ma (Ballynamuddagh) and 415.6±2.5 Ma (Dhoon) with a weighted average of 417.2±1.7 Ma (MSWD = 1.3). The Foxdale Granite and a sample from the Rockabill Granite yielded younger ages of c. 397 Ma, whereas another Rockabill sample yielded an older concordia age of 427.7±3.4 Ma.

Inherited zircons (487 to 453 Ma) occur in all three age groups, and are interpreted to have been derived from Ordovician arc magmatic rocks accreted within the ISZ. A younger group of c. 440 Ma inherited zircons occurs in the c. 417 Ma Crossdoney and Ballynamuddagh granites. These grains could be related to continued or renewed Silurian arc magmatism.

Granites in the 417 Ma age group are the most 'primitive', being metaluminous with high Mg# and low Ti, Cr, Ba and Sr concentrations, and are mineralogically I-Type, consistent with a major contribution from older arc sources. Relatively few analyses are available but granites of the 428 and 397 Ma age groups have some characteristics of S-type granites, consistent with predominantly sedimentary source rocks or contaminants.

[1] Atherton & Ghani (2002), *Lithos 62, 65-85*.

Experimental efforts to understand deep mantle melting

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There is evidence from seismology and from metasomatised mantle xenoliths for the presence of melting in the mantle at depths significantly greater than 50 km. At the very base of the mantle the detection of ultra low shear wave velocities may indicate melting due to the thermal boundary layer at the core mantle boundary, or may be evidence for chemical heterogeneity at the base of the mantle. On the other hand, melts that modify the roots of cratonic continental lithosphere arise from the presence of volatiles in the deep mantle. Understanding the implications and consequences of such melting requires the ability to determine the compositions and temperatures at which melting occurs under pressure.

We have performed experiments to examine simple melting relations in the systems MgO-FeO-SiO_2 and examined the effects of H_2O, CO_2 and other components on the depression of melting temperatures. The relatively simple phase relations are amenable to the thermodynamic treatment of silicate melts, which can be used to then extrapolate melting relations over much wider ranges of pressure and temperature. In addition by modelling experimental data some idea of the mechanisms by which components are incorporated in melts can be gained.

We show that melting relations of bulk silicate earth compositions at high pressure can be well described on the basis of phase relations of a simple ternary at high pressures. These results can be used to examine a partial melt origin for the existence of low shear wave velocities at the core-mantle boundary. Models for the effect of volatiles on melting relations are used to examine how melt fractions will vary throughout the upper mantle as a function of bulk volatile concentration.

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