

## Calibration and scaling of cosmogenic nuclide production rates

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Empirical calibrations provide constraints on cosmogenic nuclide production rates at specific sites, over specific exposure periods. The resulting production rate estimates can only be compared with the aid of scaling functions that correct for differences in atmospheric and (time-averaged) geomagnetic shielding between different sites. Several scaling procedures have been adopted, and a meaningful comparison between published calibration studies must be based on a common scaling procedure. Conversely, calibration measurements distributed over a range of latitudes, altitudes and exposure times can also be used to evaluate different scaling procedures.

A common-basis comparison of calibration studies of the  $^{10}\text{Be}$  production rate in quartz shows much better agreement than published estimates imply. Apparent disagreement between studies that suggest a sea level, high latitude production rate of  $\sim 6$  atom/g/yr (mostly derived from high altitude sites), and those that estimate a rate of  $\sim 5$  atom/g/yr (mostly from sites near sea level), can be traced to overestimation of the muon capture yield. Incorporating a reduced muon yield into the scaling factors produces excellent agreement (chi-squared  $\sim 0.8$ ) among all calibration data, at a sea-level production rate of  $\sim 5.1$  atom/g/yr.

The  $^{10}\text{Be}$  calibration data can also be used in the opposite sense, to compare and evaluate proposed scaling and paleomagnetic correction procedures. Results will be presented at the meeting.

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## Integration of Phase Equilibria Modelling and Garnet Sm-Nd Geochronology for Construction of P-T-t Paths: Examples from the Cordilleran Coast Plutonic Complex, USA

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Integration of petrographic observations, mineral chemistry, garnet Sm-Nd isochrons, and MnNaCaKFMASH pseudosection phase equilibria models constructed with THERMOCALC provides quantitative metamorphic pressure-temperature-time (P-T-t) paths which allow determination of assemblage/reaction history for pelites. Examples are presented for the Cretaceous to Tertiary magmatic arc of the North American Coast Plutonic Complex (CPC). Metamorphism in the western CPC in SE Alaska and the North Cascades in Washington resulted from at least 3 widespread events from  $>100$  Ma to *c.* 60 Ma, and in both areas partly resulted from crustal thickening, evidenced by kyanite after andalusite.

The western CPC, SE Alaska, was effected by  $>2$  metamorphic events, making age/event assignment difficult. Core, intermediate, and rim segments obtained from two 2 cm garnet crystals from Garnet Ledge yield ages from  $89.9 \pm 3.6$  to  $89.0 \pm 1$  Ma indicating that metamorphism was near-synchronous with emplacement of a nearby pluton ( $91.6 \pm 0.5$  Ma, U-Pb zircon) and garnet growth lasted  $<2$  m.y. P-T-t paths indicate initial garnet growth in the staurolite zone, *c.* 50°C above the predicted Grt-in line, and a  $\leq 1$  kbar P increase.

An extensive region NE of the Mt. Stuart batholith in the North Cascades underwent a significant P increase; however, the timing and nature of high P metamorphism is controversial. P-T-t paths constructed for garnet growth along the NE margin of the batholith, indicate that 88-86 Ma garnet growth was younger than the nearby Mt. Stuart ( $93.5 \pm 1.4$  Ma, U-Pb zircon). Garnet core and rim segments are isochronous indicating a short interval for garnet growth. P-T-t paths from dated rocks indicate garnet growth in the sillimanite stability field during a maximum P increase of 1 to 2 kbars, after rocks passed through andalusite stability (Mt. Stuart contact metamorphism).

Careful garnet sampling, hand-picking, and leaching can provide clean separates, with REE concentrations that compare well with independent determinations, that provide geologically consistent ages. Garnet growth T from core chemistry are above pseudosection garnet-in lines, compatible with reaction overstepping. Calculated P-T-t paths provide important results for interpreting regional and contact metamorphism.