Nd-isotope evolution in the Cretaceous Gault and chalk seas (Albian–Maastrichtian)

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Nd isotopes recovered from Cretaceous fossil fish teeth can promote understanding of ocean circulation during this Period [e.g. 1-2], but this goal is limited by the sparsity of available data. This study presents a new time-series of Nd isotopes obtained from fish teeth collected mainly from the Gault Clay and English Chalk in the UK, spanning ~ 110 – ~ 67 Ma.

ε_{Nd} values range from ~ -8 to ~ -12.5 in the mid- to Late Cretaceous. The data show a clear decreasing trend from ~ -9 to ~ -10.5 from the early Albian to late Albian. Data from the Cenomanian–Turonian range from ~ -8.5 to ~ -11, and then reach the lowest values of ~ -12.5 in the Santonian and early Campanian, and finally recover to ~ -9 in the Maastrichtian.

Comparison with weathering proxies allows this effect to be deconvolved from circulation changes. For example, the parallel increase in the Nd-isotope and Sr-isotope ratios [3] from the early Campanian to Maastrichtian supports the idea that this increasing trend in the Nd-isotope record reflects the reorganization of ocean circulation; otherwise the enhanced global continental weathering, as indicated by Sr isotopes, should have driven the Nd isotopes in the opposite direction.

Interestingly, the low Nd-isotope values found in the Santonian and early Campanian in our record happened coincidently with major changes in Nd isotopes in the South Atlantic [2]. This coincidence in timing might suggest that changes of ocean circulation patterns in the NW European area are caused not only by local processes, but are also related to large-scale reorganization of ocean circulation induced by global tectonic movements.

[1] Pucéat *et al*. (2005), *EPSL* **236**(3-4), 705-720. [2] Robinson *et al*. (2010), *Geology* **38**(10), 871-874. [3] McArthur *et al*. (2001), *J. Geol*. **109**, 155-170.

Growth of zircon and rutile during continental subduction-zone metamorphism: A case study of UHP eclogite in the Dabie orogen

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Both time and temperature of zircon formation can be directly dated by the U-Pb chronometer and the Ti-in-zircon thermometer, respectively. However, difficulty is encountered for rutile due to the effects of high common Pb on the U-Pb dating and pressure variable on the Zr-in-rutle thermometer. This is particularly so for Dabie-Sulu UHP eclogites of China, which gave consistently lower Zr-in-rutile temperatures than known estimates. Nevertheless, a combined study of zircon and rutile enables tight constraints on P-T-t path of continental subduction-zone UHP eclogites. We measured the Zr content of rutile by both EMP and LA-ICPMS for low-T/UHP eclogit in the Dabie orogen. Zircon U-Pb isotopes and trace elements were analyzed by LA-ICPMS, yielding U-Pb ages of 242±4 Ma and Ti-in zircon temperatures of 713±17°C for Group I zircons, and U-Pb ages of 226±2 Ma and Ti-in-zircon temperatures of 681±12°C for Group II zircons. The Zr-in-rutile temperatures were calculated and interpreted based on possible P-T-t paths for the eclogite. Most inclusion and matrix rutiles yield Zr-in-rutile temperatures of 574 to 658°C at 2.5 GPa and 593 to 680°C at 3.3 GPa. This suggests that these rutiles would grow below and at the peak pressure during continental subduction. A few inclusion rutiles give high temperatures of 719-757°C at 2.0 GPa, consistent with their growth at the peak temperature during HP eclogite-facies recrystallization in response to the "hot" exhumation. Thus, the Zr-in-rutile thermometry is capable of providing metamorphic temperatures for rutile growth provided if petrological and geochronological constraints are available on their P-T-t paths. Although the secondary Zr loss of rutile could be enhanced by fluid-assisted recrystallization, the slow rate of Zr diffusion in rutile makes it impossible as an efficient mechanism for a considerable change in rutile Zr content at the eclogite-facie conditions. Therefore, the remarkable differences in Zr content and thus in temperature between the different occurrences of rutile suggest that many rutiles did not grow at peak P-T conditions. In other words, the Zr-in-rutile temperatures can be used to indicate rutile growth in the different stages of continental subduction-zone metamorphism.