Geochemical insights into reworking of juvenile and ancient crustal rocks in arc-continent and continent-continent collision zones

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With the development of plate tectonics, significant differences have been recognized in subduction-zone metamorphism during plate convergence. This is indicated by contrasting geological occurrences, mineral assemblages, and physico-chemical conditions of peak metamorphism. Thus subduction zones can be categorized into Pacific and Alpine types based on the geochemical nature of subducted crust. The Alpine-type subduction involves the possible closure of backarc basins, arc-continent, continent-arc-continent or continent-continent collision without syn-subduction magmatism. Thus, the Alpine-type collision reworks preexisting terranes, resulting in reworking of preexisting crust rather than growth of juvenile crust. Whole-rock Nd and zircon Hf isotope studies enable distinction between different ages of the continental crust. While the juvenile crust is indicated by positive ε_{Nd} (t) and ε_{Hf} (t) values with young Nd and Hf model ages close to timing of magmatism, the ancient crust is characterized by very negative ε_{Nd} (t) and ε_{Hf} (t) values with very old Nd and Hf model ages.

Although the two types of plate convergence can be distinguished from tectonic observations, there are a number of transitions between them. Thus, continental collision zones are further classified into two types also based on the geochemical nature of subducted crust. One is the Himalaya-Tibet type that starts from the Alpine type arc-continent collision with contemporaneous metamorphism and magmatism. Ultimately, it evolves into continent-arc-continent collision orogens, with or without HP to UHP metamorphism. This leads to broad intercontinental orogens with reworking of juvenile crust. The other is the Dabie-Sulu type in which the subduction of one granitic crust-capped continental plate beneath the other continental plate to bring about UHP metamorphism during continent-continent collision, with no juvenile arc between the collided continents. This results in narrow intercontinental orogens and reworking of relatively ancient crust. While variable ε_{Nd} (t) and ε_{Hf} (t) values for continental igneous rocks suggest mixing between different ages of crustal materails, reasonable identification of endmember component holds a key to the hypothesis about crust-mantle interaction during magmatism of interest. In particular, positive ε_{Nd} (t) and ε_{Hf} (t) values for them do not mean that their magma source is the asthenospheric mantle.

Role of morphology in the aggregation kinetics of MeO nanoparticles

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The aggregation kinetics of two types of ZnO nanoparticles has been investigated under various conditions. Distinct differences in aggregation kinetics were observed between the two ZnO particles. The aggregation of the nearly spherical ZnO (denoted as Me ZnO) exhibited strong dependence on the ionic strength (IS) of the solution; while minimal influence of IS was seen on the irregularly shaped ZnO (mixture of slab-like and rod-shaped particles, denoted as Mk ZnO) in the IS ranged tested. It is postulated that the Mk ZnO possesses a critical coagulation concentration (CCC) below the lowest electrolyte concentration tested (1 mM NaCl) due to the interactions between various surfaces. The CCC of ZnO was found to be a function of pH; the CCC increased significantly as the pH was further away from the point of zero charge. Natural organic matter (NOM) was found to substantially hinder the aggregation of both types of ZnO particles (above 10 mg/L for the Me ZnO and above 1 mg/L for the Mk ZnO). To our knowledge, this is the first study to report the effect of particle morphology on nanoparticle aggregation kinetics, which outlines the importance of accounting morphology into nanoparticles' environmental transport assessment. Current ongoing work is to further investigate the role of morphology under more controlled condition. TiO_2 nanoparticles with rod, sphere, and wire morphology are being studied for the difference among their aggregation processes.