# Geochemical features of a paddy soil chronosequence derived from calcareous marine sediments in a millennium scale

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Paddy soils are important soil resources for food production especially in Monsoon Asia. Knowledge of the effect of human activity under wet cultivation over time on soil geochemical behavior is useful for the improvement and sustainable use of these important soil resources.

Five paddy soil profiles developed on fairly uniform calcareous marine deposits under nearly identical landscape and climate conditions from Cixi, Zhejiang Province, China, as a chronosequences with 0 to 1000 years paddy cultivation time, were studied. The gain and loss of macro- and mirco-elements were compared by a mass-balance approach [1], using Ti as immobile element and uncultivated soil as the original soil.

The loss of Ca, Na and Mg occurred in the paddy profile within 50 years of cultivation history (the weighted average value of -56% for Ca, -27% for Na, and -10% for Mg) and shows increasing trend against paddy cultivation age. Comparatively, the migration rates of Al and Si were quite small and generally less than 14% in a millennium scale. Al was relatively enriched and shows no trend with paddy cultivation age, but Si is gradually depleted with increasing paddy cultivation time. For Fe and K, which are characterized by basically constant mean value in overall profiles and large depth variation with loss in the surface horizon and gain in the subsurface horizon (mainly between 40 cm and 80cm). In addition, the horizon differentiation of Fe tends to increase with cultivation history. P and Mn are characterized by the slightly enriched in the paddy cultivation initial stage (50 years) and remarkable loss in the paddy cultivation age more than 700 years. Our data demonstrate that wet cultivation has profound impacts on geochemical behaviors of various elements which may affect soil productivity and quality.

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[1] Brimhall (1987) *Geochim. Cosmochim. Acta* **51**, 567–587.

# Hydrogen isotopes and water contents in minerals from UHP metamorphic rocks

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The fluid regime during subduction and exhumation is one of the most important concerns in the study of metamorphism, magmatism and mineralization in collisional orogens. Water contents in nominally anhydrous minerals (NAMs) can provide a unique perspective on fluid activity during subduction-zone metamorphism, whereas stable isotopes can place direct constraints on the origin of metamorphic fluid. A systematic study of hydrogen isotopes and water contents in hydrous and anhydrous minerals were carried out for UHP metamorphic rocks from the main hole of Chinese Continental Scientific Drilling (CCSD) in the Sulu orogen, China. The results provide insights into the origin and action of metamorphic fluid in continental subduction zones.

Retrograde metamorphism has made different effects on UHP mineral and isotope systems during the exhumation of deeply subducted continental crust. Despite the extensive retrogression, the signature of meteoric water is still preserved in the minerals. Significant amounts of water are present in the forms of structural hydroxyl and molecular water in NAMs. Combined with hydrous minerals, they make up the water deposit in the UHP slab and thus have important contributions to the fluid regime and chemical geodynamics of continental subduction and exhumation.

There are negative correlations between water contents and δD values for garnet, omphacite and rutile, indicating preferrential loss of the molecular water from the NAMs during exhumation. In this regard, the measured $H_2O$ amounts of NAMs may be only the minimum estimates of actually dissolved water at mantle depths. Quantitative estimate suggests that the decompression exsolution of structural hydroxyl and molecular water can provide a sufficient amount of water for amphibolitization of UHP eclogites. The occurrence of D-rich retrograde fluids suggests involvement of hydrous minerals in the retrograde fluid. In either case, the retrograde fluid is essentially a kind of deuteric fluid that is cognate and evolved from within the system. Granitic gneiss is capable of storing more water than the eclogite under the same UHP conditions and thus can release more water than the eclogite during the initial exhumation of deeply subducted slabs. The difference in water contents result in the different behaviors of eclogite and gneiss during the exhumation.