Crustal weathering in the Changjiang drainage basin and the evolution history of the river

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During the Cenozoic the Tibetan uplift impacted significantly on the evolution of the Asian monsoon and the development of mega-rivers in Asia [1]. The Changjiang (Yangtze River) as the longest and largest river sourced from the Tibetan area, has increasingly attracted world-wide research attentions over the last decade with emphasis on its evolution history and sediment transport pattern [2, 3].

In this study systematic sediment samples were collected from the major tributaries and mainstream of the Changjiang for geochemical measurements including rare earth elements, Sr-Nd isotopes and chemistry of detrital zircon and monazite grains. Compositional variability among different sub-catchments indicates distinct crustal weathering patterns with several tectono-thermal events dominant. In particular, the sediment contributions from the specific provenance rocks such as the large Emeishan Basalt Province and Himalayan igneous rocks in the upper basin can be well recognized by the distinct elemental and isotopic compositions as well as detrital single-mineral ages.

Geochemical studies on two long drilling cores (PD and DY03) from the Changjiang Delta suggest that the provenances of sediments into the delta area significantly changed since the early Pleistocene. Such a drastic change may be diagnostic of the evolution of the paleo-Changjiang drainage system, in relation to strong uplift of the eastern Tibet during the late Pliocene. The incision of the Three Gorges took place at the same time [4, 5], which correspondingly allowed detritus from the upper basin to be transported to the present Changjiang estuarine area.

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Abnormalously high $^3He/^4He$ ratios of fluid samples from non-volcanic area of western Taiwan

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Representative gas samples of fumaroles, springs, mud volcanoes, natural gases were collected from Taiwan for helium isotopes measurement. Samples from northern and eastern Taiwan exhibit higher $^3He/^4He$ ratios, which indicates significant mantle-derived signature [1, 2, 3]. The result is not unexpected, since hydrothermal activity is still active at those areas. Nevertheless, some anomalously high $^3He/^4He$ ratios (up to 6.4 Ra) are obtained from non-volcanic area in western Taiwan. Carbon isotopes of CO_2 and $CO_2/^3He$ ratios in those samples are similar with those from mid-ocean ridge basalts, which believed to be derived from upper mantle. Hence, we are able to conclude that they are mantle-derived.

Intrusive magmatism and/or deep normal faults occurred in western Taiwan could be the straight forward way to explain the high helium isotopic ratios observed in non-volcanic area. Considering the possible inversion of tectonic stress from compression to tension, post-collisional magmatism around northern Taiwan may have occurred since late-Pliocene. The model might explain the possible mantle source for northwest Taiwan area, however, it is still unable to demonstrate why there is no any magmatic activity reported since late-Miocene and, presently, the areas are still under severe tectonic compression environment where we found the high helium ratio samples, especially in southwestern Taiwan.

I propose that the high $^3He/^4He$ ratio gases are not *in situ* mantle-derived volatiles. They may be associated with Miocene magmatism and have been trapped by impermeable formation during the stage of basin subsidence before orogenic event occurred. Consequently, the deep normal faults may be reactivated as reverse faults by continuous compressive stress and cut through the capped rock of the gas reservoir. The “old” mantle gases, hence, could be released to surface through the leakage.

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