Nd-Sr-Pb isotopic compositions for red residua underlying dolomites in Karst Terrains of Guizhou Province

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Well-developed, clay-rich soils are widespread in the global karst terrains, for their genesis has been debated for several years. The article presents the Nd-Sr-Pb isotopic composition for Pingba red residua profile underlying dolomites in the Triassic karst terrains of Yunnan-Guizhou Plateau, provide strong constrains on the material sources of regolith, and also acquirement into isotopic fractionation in the chemical weathering processes. It is suggested the insoluble residues from underlying Triassic dolomites as the domination of parent materials for the red residua.

The results of isotope analysis for bulk samples showed that the $^{87}Sr/^{86}Sr$ ratios varied relatively greatly, from 0.708 to 0.747, but the $^{143}Nd/^{144}Nd$ ratios displayed a little variation, from 0.5121 to 0.5124 ($\Sigma Nd_{(0)}$ =-9.6- -11.5). The isotopic compositions of Pb belonged to “ordinary lead” which was derived from feldspar minerals, and $^{206}Pb/^{204}Pb$ was little change, about from 19.0 to 20.6. The ratios of Pb isotopes in this study were clearly different from the ratios of Pb isotopes from the average crust, the background of research regions and aerosols in China. The sample points of Pb isotopes were fallen on a mixed line, and the reason for their formation had been suggested in this study.

With increasing weathering intensity, $^{87}Sr/^{86}Sr$ and Sm/Nd ratios in the weathering front showed a decreased and increased variation, respectively. The change with Sr and Nd isotopic system, were chiefly derived from the early stage of weathering, either the water rock interaction or preferentially weathering the different Rb/Sr ratios of the minerals. From the element balance calculation and variation of $^{87}Sr/^{86}Sr$ ratios, the leaching weathering of dolomite, rare earth minerals and feldspar minerals were been discovered during rock-soil alteration processes, respectively. The Pingba profile had experienced a primary weathering process and the two-stage nature of weathering could be distinguished precisely, which determined the processes of dissolution and resetting for Nd-Sr isotopic system.

A ^{15}N-enriched Archean crust

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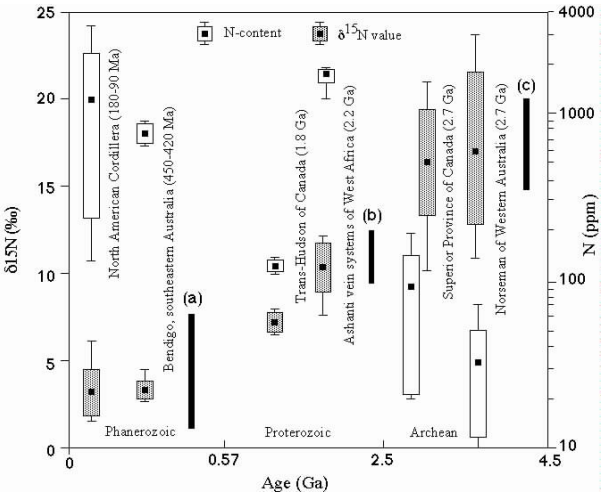
New measurements of the N-isotope composition of 2.7 Ga Archean metasedimentary rocks, and K-micas in hydrothermal systems that sample average crust, both yield $\delta^{15}N$ values of 16 to 24‰, compared to 7 to 10‰ in Paleoproterozoic and 2 to 6‰ in Phanerozoic counterparts, implying a secular decrease in crustal $\delta^{15}N$ (Fig. 1).



Present-day atmospheric N_2 of 0 ‰ is sequestered by microorganisms, converted to N-bearing kerogen in sediments with average $\delta^{15}N$ of 3 to 4‰, and a proportion retained as NH_4^+ substituting for K in crustal rocks, giving a crust - atmosphere fractionation of 3 to 4‰. Consequently, if N-isotope fractionation between them in the Archean is the same as at present, then the ^{15}N enriched 2.7 Ga Archean crust is consistent with an atmospheric value of 13 to 21‰.

These results endorse the model of the Earth’s secondary atmosphere forming by late accretion of volatile rich C1 carbonaceous chondrites ($\delta^{15}N$ = +30 to +42‰) and comets at ~ 4.5 Ga. Consequently, the present atmospheric N-isotope composition can be accounted for by progressive sequestration of atmospheric N into crustal rocks, as tracked by the secular variation of crustal $\delta^{15}N$.

References

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