Local response to global Mesozoic overturn: Inferred from SHRIMP zircon dating of lower crust xenoliths, North China Craton

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The large scale subcontinental lithosphere thinning beneath North China Craton in Mesozoic-Cenozoic is well recognized as a major geodynamic process in eastern China, especially in the eastern part of North China Crtaton, but there has always been controversy as to when and what the timing, mechanism and consequence related to this event is. Based on a systematic study on granulite and pyroxenite xenoliths entrained in Neogene basalts, North China Craton, with emphasize on SHRIMP U/Pb dating of zircons, we hereby present direct geochronological evidence for timing of basaltic underplating, fractional melting and magma cumulate. Although the entire data sets display a complicated and multiple-peak spectrum, which prominently defines a broad peak of activity between 80 and 120 Ma and, the peak around 160 to 180 Ma in the duration of Mesozoic. They would be responsible for the surface expression of Late Mesozoic intensive and voluminous granitoids, volcanic rocks, diorites, dikes and widespread gold mineralization in that region. It reflects the multiple episodic thermal perturbation beneath North China Craton, resulting in major transformation of architecture of subcontinental lithosphere. It is inferred that the global cretaceous catastrophic geodynamic process in deep mantle, most likely, would coincide with, and then, should be responsible for these events.

Noble gas tracing of coalbed methane generation and biomodification

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Fractured coalbeds can provide a commercial methane gas resource and because of their high sorbtive gas capacity are a potential target for CO_2 sequestration projects. The San Juan Basin is located on the eastern margin of the Colorado Plateau, USA. Biodegradation of the Late Cretaceous coal seams produces one of the worlds largest non-conventional methane natural gas resources. The highest regions of gas production correlate with changes in groundwater chemistry indicative of recent groundwater involvement in the coal biodegradation. Furthermore, in the high gas production regions spatially coherent changes in CO_2/CH_4 ratios correlate with $\delta^{13}C(C2)$ and C2 content. These can be fitted to a simple Rayleigh fractionation model and has been interpreted as bio-modification of the natural gas composition.

Noble gases from groundwater are isotopically distinct, and their elemental abundance pattern is only changed by physical processes. Noble gases can therefore play a dual role in both quantifying the role of the groundwater system in the biodegradation process as well as resolving compositional and isotopic fractionation caused by sorbtion/desorbtion from the coal surfaces.

26 samples have been collected for compositional, stable isotope and noble gas determination. 8 of these are from a region showing no coal bed biodegradation. These provide a control and show a coherent increase in $^{40}Ar/^{36}Ar$, $^{3}He/^{4}He$ and $^{21}Ne/^{22}Ne$ ratios, from 384 to 625, 0.0836Ra to 0.168Ra and 0.0213 to 0.0343 respectively, with distance from the basin margin. Groundwater-derived noble gas concentrations (^{20}Ne, ^{36}Ar, ^{84}Kr and ^{136}Xe) all decrease with increasing distance from recharge. Preliminary results from the high production/biodegraded regions show concentrations of atmosphere-derived noble gases up to three orders of magnitude lower than the control. These gases are highly fractionated with $^{20}Ne<^{36}Ar<^{84}Kr<^{136}Xe$ relative to groundwater values. These results are interpreted as a combined effect of dilution and fractionation caused by desorbtion of gases from the coal during production.

References

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