Structural and geochronological studies of the Fuping Complex: New constraints on the tectonic evolution of the Trans-North China Orogen

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The Trans-North China Orogen (TNCO) is interpreted as the site where two discrete continental blocks, called the Eastern and Western Blocks, amalgamated to form the coherent basement of the North China Craton in the late Paleoproterozoic[1-2], but its deformational history and timing have not been well constrained. In this study, we present structural and SHRIMP zircon data for the Fuping Complex, one of the largest complexes in the TNCO. Detailed mapping and structural investigations reveal that the Fuping Complex experienced four distinct deformational episodes (D_1 to D_4). The D_1 is characterized by isoclinal tight fold (F_1), penetrative F_1 fold axial planar foliation (S_1) and mineral lineation (L_1). Earliest L_1 displays a preferred NW-SE orientation with a shallow plunging angle, indicating the earliest direction of collision. The D_2 is the major deformation episode in the complex, represented by ubiquitous E to SE-verging isoclinal, overturned -to- recumbent folds (F_2) of varying scales, F_2 fold axial planar foliation (S_2) and crenulation lineation (L_2). Both D_1 and D_2 deformations corresponded for the prograde metamorphism (M_1). The extensional D_3 generated regional-scale NW (W)-SE (E) trending upright open folds (F_3) that warped the whole complex into dome and basin patterns. The last D_4 is characterized by brittle fabrics and low-angle detachments, which are related to the complete exhumation of the complex. Both D_3 and D_4 corresponded for the decompression (M_2) and retrograde (M_3) metamorphism, respectively.

SHRIMP U-Th-Pb zircon ages from leucocratic dykes reveal that pre-D_1 leucocratic dykes were emplaced at 2484±13 Ma, whereas zircons from syn-D_2 folded leucocratic dykes yield SHRIMP zircon ages of 1843±12 Ma and 1844±18 Ma, respectively. Zircons from post-D_2 leucocratic dykes give SHRIMP zircon age of 1817±14 Ma, older than published zircon ages of 1790±8 Ma and 1799±9 Ma for post-tectonic undeformed granitic pegmatite dykes. Structural and SHRIMP U-Th-Pb zircon data indicate that the Fuping Complex, together with adjacent Wutai and Hengshan Complexes, underwent uniform deformational histories incorporated into an eastwards subduction during final assembly of the North China Craton at ~1.85 Ga.

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FTIR features of coals from the Ordos Basin (NW China): Implications on hydrocarbons from coal

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The Ordos Basin, located in NW China, is typical of accumulation of multi energy resources including oil, gas and coal. We have porfomed the study on some coal samples with variable maturation from brown coal to anthracite by Fourier Transform Infrared (FTIR) Spectroscopy analyses. The goal is to have a deeper understanding of the evolution of hydrocarbons from coal. The method of curve-fitting analysis was used in order to more precisely quantify peak areas of different coal structure. Despite of the fact that the studied samples are not along a natural series due to different bio-precursors, they may also imply the ability and evolution of hydrocarbon generation of coals. Analytical results indicate that variation of IR spectra corresponds to the stage of hydrocarbon generation relatively well.

Firstly, when vitrinite reflectivity (Ro) of the samples is below 0.6%, IR spectra area around 1705 cm^{-1} which represents stretching vibration of oxygenous groups in coal descends fastly with the maturation increasing. This implies that a lot of hydroxyl group and methoxyl group break off from coal and become carbon dioxide to migrate. IR spectra area of 2950 cm^{-1} and 2920 cm^{-1} represents asymmetric stretching vibration of methyl and methylene, respectively. However, we did not observe a clear change of these two function groups. In this stage, only a few amounts of oil and gas were generated based on thermal simulation experiment of brown coal.

Secondly, when Ro of the samples reaches 1.3%, FTIR spectra area around 1705 cm^{-1} decreases to zero. Meanwhile, IR spectra area of 2950 cm^{-1} and 2920 cm^{-1} diminish continuously, which means plenty of aliphatic group and aliphatic ring break off to becoming oil and gas. The ratio of methyl (CH_3) to methylene (CH_2) representing the length of aliphatic chains of coal and a branching index increases. This may be ascribed to the break of long aliphatic chains and the conversion of hydroaromatic methylene structures to aromatic rings during hydrocarbon generation. A large amount of oil and gas have been generated through the thermal simulation experiment, and the coal almost reaches the hydrocarbon generation peak in this stage.

Thirdly, when Ro exceeds 1.3%, IR spectra area of 2950 cm^{-1} and 2920 cm^{-1} disappear, and the process of hydrocarbon generation from coal stopped. The CH_3/CH_2 ratio does not represent the length of aliphatic chains here. In summary, abundance of hydrogen and oxygen in coal decreases and carbon concentrates along with the coal rank increasing and hydrocarbon generative maturation.

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