Intra-reservoir geochemical heterogeneity in the Shixi oilfield of the central Junggar Basin, China

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The Shixi oilfield is located in the central Junggar Basin, northwestern China. Prevoious geologic and geochemical studies have suggested that the West Pen 1 Well sag to the southwest was the hydrocarbon kitchen, in which there existed mainly two sets of Permian source sequences (the Lower Permian Fengcheng and Middle Permian Lower Wuerhe Formations). Petroleum exploration results show that hydrocarbons have been produced mainly from two sets of reservoirs, i.e. the deeper Carboniferous volcani-clastic and upper Jurassic clastic ones. In this study, we aim to unravel intra-reservoir geochemical heterogeneity within these two sets of reservoirs and tentatively discuss its controlling factor.

According to geochemical anslyses, carbon isotopes and maturity of oils from the Carboniferous reservoir are greater than those from the Jurassic one, while density of the oils is lower in the Carbonniferous reservoir. This likely implies that the oils in these two reservoirs have undergone different petroleum migration and accumulation process.

To approve this, we carried out artificial oil mixing experiments. After detailed geochemical analysis, we find that the distribution pattern of C_{20}-C_{21}-C_{23} tricyclic terpanes varies along with oil-mixing ratio accordingly. Based on this, we studied the characteristics of oils in the two reservoirs. It is indicated that in the Carboniferious reservoir, petroleum sourced from Lower Wuerhe Formation have a higher proportion than from Fengcheng Formation, however, this trend is to the contrary in the Jurassic reservoir.

Also, we studied the history of petroleum accumulation. The results show that the petroleum sourced from Fengcheng Formation migrated into the Carboniferious reservoir in Triassic, and then, adjusted into the Jurassic reservoir in Late Jurassic. The petroleum sourced from Lower Wuerhe Formation inpoured into the two reservoirs in Late Cretaceous.

According to our research, the key event caused the heterogeneity is the adjuster of the petroleum sourced from Fengcheng Formation in Late Jurassic. Because of this event, the proportions of petroleum sourced from Fengcheng and Lower Wuerhe Formation in two reservoirs are not consistent. As a result, the carbon isotopes, marturity and density of the oils in these two reservoirs are different.

Interactions between carbonate magmas and MARID metasomes: The case of diamondiferous aillikites from the Torngat Mountains, Canada

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Aillikite magmas (a carbonate-rich ultramafic lamprophyre; UML) erupted through the Archean crust of the Torngat Mountains in northern Labrador between 610 and 550 Ma. These dykes are characterized by long-term isotopic depletion ($^{87}Sr/^{86}Sr$ = 0.70323-0.70377; εNd = +1.2 to +1.8; εHf = +1.4 to +3.5; $^{206}Pb/^{204}Pb$ = 18.2-18.5), but grade into carbonate-poorer mela-aillikites which show isotopic enrichment ($^{87}Sr/^{86}Sr$ = 0.70388-0.70523; eNd = -0.5 to -3.9; eHf = -0.6 to -6.0; $^{206}Pb/^{204}Pb$ = 17.8-18.2). This long-term enriched signature is coupled to distinctively higher Rb/Cs and Zr-Hf-Ti. Increased partial melting involving old phlogopite- and rutile-bearing source material reminiscent of MARID probably imparted this signature to carbonate-rich aillikite magmas, thereby shifting compositions towards mela-aillikites. Channelling of CO_2-rich melts into pre-existing MARID vein networks in the lower reaches of the cratonic lithosphere and their varying interactions best explains the aillikite/mela-aillikite continuum. As there is no evidence for independent melting of the low-T fusible MARID veins, temperatures during aillikite magma generation may never exceed 1200°C. Thus, decompression and volatile-fluxing are the principal causes of UML/carbonatite magma generation within rifting cratonic mantle. Strong interactions between CO_2-rich melts and lithosphere are unavoidable, explaining the rarity of direct eruptions of primary carbonatite magmas. The degree of interaction controls whether CO_2 (i) remains dissolved in UML magmas, enabling separation of carbonatite intrusions at crustal levels, or (ii) largely reacts out at mantle depths resulting in carbonate-poor UML magmas, as in the Torngat examples.