6th Edition
AAPG Siliciclastic Reservoirs of the Middle East GTW
1-3 December 2025 | Kuwait City, Kuwait

Sandstone-Hosted Sediimentary Copper Deposits

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Abstract

Sedimentary rock-hosted copper deposits account for nearly a quarter of the world's production of copper and over 60% of cobalt. These deposits may be broadly divided into reduced shale/siltstone-hosted and sandstone-hosted deposits. Sandstone-hosted deposits generally formed following introduction of hydrocarbons into the host rocks. Sedimentary copper systems require source, transport, and trap like petroleum systems, but unlike petroleum systems the copper systems must account for sources and transport of both metals and reduced sulfur. In addition, sandstone-hosted copper deposits require a physical trap for hydrocarbons which then provide a chemical trap for the reduction reactions critical for precipitation of copper sulfides. Examples of sandstone-hosted copper deposits from both the Neoproterozoic Central African Copperbelt of Zambia and the Democratic Republic of Congo (DRC) and the Carboniferous Chu-Sarysu basin of Kazakhstan are used to illustrate evolution of these mineralized systems. The Mufulira deposit in Zambia (332 Mt at 3.15% Cu) is a world-class deposit at the base of the local stratigraphic section. The deposit occupies a 3-way structural/stratigraphic trap. Hydrocarbon migration, recognized from remnant bitumen, preceded copper mineralization. Copper mineralization resulted in hydrocarbon destruction, production of hydrogen sulfide (reduced sulfur for copper sulfide precipitation), and alteration of feldspar in the host rock to muscovite and carbonate dissolution. The Dzhezkazgan deposit in the Carboniferous Chu-Sarysu basin of Kazakhstan is the world's largest known sandstone-hosted copper deposit with 2000 Mt of 1.1% Cu. The deposit contains a number of individual stratabound orebodies that appear to have formed by interaction of metalliferous brines with hydrocarbons trapped within channel sands along a major anticlinal structure. The talk will present key similarities and differences between petroleum siliciclastic reservoir systems and sandstone-hosted copper systems and address exploration strategies for sandstone-hosted copper systems going forward namely the use of seismic geophysics in a near-surface (<2 km) environment.