

Tethyan Salt Diapir-Related Mississippi Valley-Type Pb-Zn Deposits of Tunisia and Eastern Algeria Atlasic Province

Salah Bouhlef,^{1,*} David L. Leach,² and Hechmi Garnit¹

¹University of Tunis el Manar, Faculty of Sciences of Tunis, UR11ES16 Earth Sciences Department, Tunis 2092, Tunisia

²Colorado School of Mines, Department of Geology and Geological Engineering, Golden, Colorado 80401, USA

*Corresponding author: e-mail, salah.bouhlef@gmail.com

The Pb-Zn (\pm Ba \pm Sr \pm F) ore deposits in Tunisia and the adjacent Algeria Atlasic province belong to the Tethyan metallogenic belt. Most of the deposits are classified as salt diapir-related MVT type. A single deposit has small- to medium-sized resources (up to 8 Mt at about 5 to 15 % Pb + Zn). A number of important regional and local geological features controlled ore deposition in this province. Most of the ore deposits are distributed along parallel SW-NE-trending Tethyan faults, inverted during the Alpine Eocene-Miocene orogeny. The ores are not hosted in the diapir itself, as in the Gulf Coast (USA) metallic province, but rather in peridiapiric carbonate reservoirs. The deposits are generally located at the southeast edges of Triassic salt diapirs and especially at the northeast and southwest extremities of the diapirs. These zones correspond to areas where the diapiric structures intruded organic-rich marine strata and are cut by a NW-trending normal fault system, limiting Tertiary grabens. Most of the ore zones are located in carbonate structural traps, highly faulted and brecciated and showing abundant oil seeps.

The ore deposits can be classified into four groups based on the ore mineral assemblages present. These ore groups are briefly described, as follows: (1) celestite \pm (Pb-Zn) strata-bound replacement-type deposits within Triassic evaporite breccias at the contact between salt diapirs or salt sheets and the surrounding Cretaceous to Miocene rocks; (2) Pb-Zn (\pm Ba \pm F) stratabound replacement-type and cavity-filling deposits within Jurassic to Miocene carbonates covered unconformably by shale-rich formation; (3) Pb-Zn strata-bound replacement-type and vein-type deposits that lack Ba, Sr, or F, hosted by Late Cretaceous organic-rich limestone; (4) clastic-dominated Pb-Zn \pm As deposits (sedex) within late Miocene-Pliocene continental sequences deposited in postthrusting basins.

The Zn-Pb-Ba-Sr-F ores show distinct mineral assemblages: (1) celestite (monomineralic), (2) sphalerite and galena, (3) barite with minor sphalerite and galena, and (4) fluorite with minor sphalerite and galena. These various mineral assemblages are suggestive of contributions from at least four distinct ore fluids and/or ore-forming events that variably affected the Triassic salt diapiric structures. In most of the deposits, sulfur isotopes are homogeneous in each deposit group with common positive values. The temperature of deposition together with sulfur isotope data indicates that the reduced sulfur for metal sulfide precipitation was derived through thermochemical sulfate reduction of Triassic sulfate involving hydrocarbons produced from Late Cretaceous source rocks. The essential role of a salt diapir in the mineralization process is the formation of a structural trap or reservoir around the diapir for hydrocarbon and reduced sulfur gases. The hydrocarbon and reduced sulfur-rich reservoir in the peridiapiric zone provides a chemical trap for ascending metalliferous brines.