



## Mineralization, Mineralogy, Structure, Texture and Genesis of Ortasu Pb-Zn Deposit, NW Zanjan

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### Introduction

According to Hitzman et al. (2005) and Hayes et al. (2015), the sediment-hosted copper deposits (SHC) are stratiform disseminated to veinlet copper mineralization within the reduced black shale, sandstone, and carbonate rocks. These deposits have formed during the middle-late Paleoproterozoic (e.g., Udokan, Russia: Volodin et al. 1994, Yinmin, South China: Zhao et al. 2013) to Tertiary (e.g., Corocoro, Bolivia: Flint 1989). The SHC deposits, frequently labeled as “stratiform” or “stratabound” and/or “diagenetic” deposits have been subdivided into three types (Cox 1986, Cox et al. 2003, Hitzman et al. 2005): 1- reduced-facies (RF), 2- Redbed (RB) and 3- Revett (RV).

There are several SHC deposits in the Zanjan region hosted by the Upper Red Formation. The Chehrabad, Cherlangoush, Ghezljeh, Halab, Ortasu and Sarikand deposits are the most important ones and are well-developed in this district. These deposits consist predominantly of bedding-parallel replacement and disseminated Cu-Pb-Zn sulfides, roughly concordant with stratification. The average Cu and Pb values of these deposits are ~3 and 2 wt.%, respectively. These deposits are small but they are actively mined at present.

The aim of this work is to expand knowledge on the geological framework, mineralization features, geochemistry and genesis of the Ortasu Pb-Zn deposit. The study of the Ortasu deposit can be used as an exploration model for similar deposits

in the Zanjan district and other places.

### Materials and methods

Detailed field studies have been done at different scales in the Ortasu area. Polished thin and thin sections from mineralized zones and host rocks were studied by conventional petrographic and mineralogic methods at the University of Zanjan. Furthermore, a total of six samples from mineralized host rocks were analyzed by ICP-MS for major and trace elements and Rare Earth Elements (REE) at Lab West Co., Australia.

### Results and Discussion

The Ortasu Pb-Zn deposit is located in the northwest of Zanjan and Central Iran zone. The outcrop formations in this region involve Lower Red, Qom and Upper Red Formations from which the Upper Red Formation hosts the mineralized zones. In this region, the Upper Red Formation consists of alternation of red to brown and grey to greenish marl associated with interbedded sandstone sequences. Based on petrographic studies, composition of the mineralized host rocks are litharenite which consist of sedimentary, metamorphic and igneous fragments, quartz and feldspar. In the Ortasu Pb-Zn deposit, mineralization has occurred within two horizons of reduced-grey sandstone with about five to six m thickness and about 100 m length. These horizons contain both red oxidized zone and bleached zone with a mineralized reduced

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subzone which is located within the bleached zone.

The red oxidized zone consists of red marl and sandstone layers containing iron oxides which is located adjacent to the reduced horizons. The red color of this zone is caused by the presence of iron oxides around the grains. The oxidized pyrite crystals are the main important minerals in this zone. The bleached zone is part of sandstone sequences whose color has changed by the alteration processes. Grey and green colors in the bleached zone have occurred due to the presence of organic materials and diagenetic pyrites. The mineralization subzone has occurred within the organic materials-bearing bleached zones. Plant debris, plant fossils, diagenetic pyrites and permeability of host rock have the main important role for Pb-Zn mineralization.

Galena, sphalerite, pyrite and chalcopyrite are the main important minerals in the Ortasu Pb-Zn deposit in some parts. They have been replaced by secondary minerals such as cerussite, chalcocite, covellite and iron oxides due to the supergene and weathering processes. The most important textures in this deposit are disseminated and cemented textures. It should be mentioned that the laminated-like, framboidal pyrite, replacement and relict textures are also observed in this deposit.

The presence of fining-upward sequences is due to the sediment cycles of channels, layered structures, abundant organic materials in paleochannels and debris of plant fossil all of which indicate that the Ortasu Pb-Zn deposit is formed in a continental to tidal environment. Geochemical studies show that the sandstones were deposited in an active continental margin. These sandstones originated from felsic magmatic rock and were deposited in an arid climate condition.

According to host rock, geometry, structure and texture, and mineralogy it can be concluded that the Ortasu Pb-Zn deposit has more similarity with the distal parts of Redbed type of sediment-hosted copper deposits.

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