Greece’s geochemistry favors a potent and dynamic use of mineral resources. Among the Non-Energy Metallic Minerals commodities, base and precious metals, in particular zinc, lead, copper gold, and silver are becoming an increasingly important and rapidly growing target of the mining industry. In NE Greece, where most of the potential resources and feasible deposits are hosted, gold-polymetallic mineralizations occur in a wide range of genetic types. The mineralization potential is consistent of magmatic porphyry copper type deposits, hypothermal / mesothermal manto-type polymetallic sulphides and epithermal gold systems. Local, semi-regional and regional scales of 3D/4D models were applied in most of the above mentioned deposits types achieving new metallogenic interpretations and exploration perspectives in relation to the geology, the structural setting, the stratigraphy, the tectonic evolution, the ore bodies geometry, the alteration zones, the ore grades distribution and the genetic links between the spatially related porphyry and manto systems, based on airborne geophysics, along with further interpretations for across border and regional exploration potential. Two areas have been studied in northern Greece: a) Eastern Chalkidiki peninsula with polymetallic replacement deposits (Olympias, Madam Lakkos, Mavres Petres) and porphyry copper deposit (Skouries) and b) Thrace region with epithermal gold deposits (Perama and Agios Demetrios deposits).

Local/Deposit and semi-regional scales of 3D modelling were applied to understand better the deeper seated extensions of the ore bodies and further explore the regional metallogenic aspects. The research leading to these results has received funding from the European Community’s Seventh Framework Programme [FP7/2007-2013] [FP7/2007-2011] under grant agreement n. 228559. This publication reflects only the authors’ views, exempting the Community from any liability.

**POLYMETALLIC REPLACEMENT AND PORPHYRY COPPER DEPOSITS IN NORTH-EASTERN CHALKIDIKI PENINSULA**

**OLYMPIAS POLYMETALLIC REPLACEMENT DEPOSIT**

It is a massive stratabound manto type ore body. The mineralization is controlled by a combination of marble horizons, and deep-seated faults developed as part of the crustal reworking of the area. Two ore bodies occur at the contact between marbles and overlying gneisses. The 3D model shows that the deeper extent of the ore body makes a potential exploration target.

**SKOURIES PORPHYRY COPPER DEPOSIT**

The Skouries porphyry belongs to a series of dominantly dioritic to andesitic dikes and stocks forming a NE-SW trending intrusive belt and occurs as a pipe-like, mineralized subvolcanic body with surface dimensions of 180m N-S and 200m E-W with a vertical extent of at least 700m. The deposit is characterized by more or less concentric potassic, propylitic, phyllic and argillic alteration.

**MAVRES PETRES POLYMETALLIC REPLACEMENT DEPOSITS**

Mavres Petres, is a massive stratabound replacement deposit. The mineralization is controlled by a combination of marble horizons and deep seated faults, developed as part of the crustal reworking of the area and subsequent fluid movements.

**NORTH-EASTERN CHALKIDIKI SEMI-REGIONAL 3D MODEL**

The geological setting, structural analysis and geophysical data based on fifteen (15) cross sections were 3D modeled to highlight the major metallogenic players in the area.

**EPITHERMAL GOLD DEPOSITS IN WESTERN THRACE**

In the area of the deposit strongly altered agglomerate andesitic tuffs, lavas and volcanic breccias are observed, showing four main (Siliceous, Advanced argillic, Propylitic and Potassic) and two overlapping (Sericite and adularia) alteration zones. The hydrothermal alteration zone of the ore bodies is characterized by vertical zonal pattern of the ore metals distribution. The main part of the base metals sulphide mineralization is controlled by volcanic breccias and tuffs at depth.

**AGHIOS DEMETRIOS EPITHERMAL GOLD DEPOSIT**

The geological setting shows biotite gneiss and amphibolite rock, showing a gold mineralization alteration. The Mavres Petres deposit is cross-cut by the major Stratoni - Varvara thrust fault and the sulphide ores extend westwards along the thrust into gold-bearing manganese deposits (e.g. Varvara, Platias). Metal grades 3D modeling indicates that high compositional variations should be expected during production.

**THRAKE SEMI-REGIONAL 3D MODEL**

Thirteen (13) geological cross sections were used across the Petrota and Kirki Tertiary basins. The N-NE, N-S and E-W deep structures form regional scale rift-fault basins (Petrota and Kirki graben). The andesitic, rhyodacitic and rhyolitic stocks and dikes appear to have N-S structural control. An extensive N-S structure of about 7.5 Km long at the western part of the area is considered to mark a fissure vent system. A set of younger NW faults have caused displacement of the structure. A geological reconstruction of the area of the Thrace epithermal deposits in semi-regional scale show N-NE and N-S structures to mark channel ways of hydrothermal fluids and fissure vent systems. In regional scale these deep structures control the formation of tertiary basins and the emplacement of intrusive rocks and correspond to the presence of alteration zones.