Seafloor massive sulfides in arcs: implications for the Aegean

Scott S.D.

Scotiabank Marine Geology Research Laboratory, Department of Geology, University of Toronto, Toronto, Canada M5S 3B1 and Marine Mining Consultants, 85 Glenview Avenue, Toronto, Canada M4R 1P9, scottsd@geology.utoronto.ca

Seafloor massive sulphide (SMS) deposits of copper, zinc, lead, silver and gold are found worldwide as products of hot spring activity on both sedimented and sediment-starved spreading ridges of ocean basins and back arcs, on abyssal seamounts, on arc volcanoes and in immature arc/back arc rifts as well as continental margin rifts. Many are modern analogs of volcanic-hosted massive sulphide (VMS) ores in the ancient geological record. Initial discoveries were made in continental margin rifts of the Red Sea (the metalliferous mud of the Atlantis II Deep) followed by low temperature springs in the Galapagos spreading and high temperature springs at 21°N on the East Pacific Rise. The early exploration focussed on oceanic spreading ridges and several large, rich discoveries were made, most notably along the slow spreading Mid-Atlantic Ridge. All of the early work on SMS was conducted by research scientists. In the 1990s, Nautilus Minerals and Neptune Minerals, two companies both based in Australia, began staking huge tracts of seabed that were known or were thought to contain SMS. Nautilus is on track to commence mining, probably in 2012, their Solwara 1 SMS deposit in eastern Manus Basin (EMB) off the east coast of Papua New Guinea that had been discovered by Ray Binns of the Australian CSIRO and the author in 1996. We were initially drawn to the EMB through the realization that decades of geological study, including our own, of VMS deposits had shown the most important ores formed during the rifting phase of island arcs. Furthermore, although not the case for the EMB, the largest VMS deposits were developed on continental rather than oceanic crust. Examples include the Iberian Pyrite Belt of Spain and Portugal, the Bathurst district of eastern Canada and the Hokuroku district of Japan. In view of the above, the submarine portions of the Aegean arc and especially its back arc hold great potential for SMS. Both subaerial and submarine hydrothermalism are known in the arc volcanoes. Of particular interest is the Anatolian Trough, an extensive, heavily sedimented back-arc rift in continental crust of the northern Aegean Sea. Nearby Lemnos and Samothrace islands are hydrothermally active. Marine geophysical data are sparse but coincident gravity and magnetic highs with high heat flow can be interpreted as indicating that igneous intrusions into the thickly sedimented crust have created hot springs on the seafloor.

Recent micro-tectonic movement from three karst caves, Slovenia

Šebela S.[1], Košťák B.[2] and Stemberk J.[2]

[1]ZRC SAZU Karst Research Institute, Titov trg 2, 6230 Postojna, Slovenia, sebela@zrc-sazu.si
[2]Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, V Holešovičkách 41, 18209 Prague, Czech Republic, Stemberk@irsm.cas.cz

Monitoring of micro-tectonic movement in Postojna cave started in 2004 and in Polog and Kostanjevica caves in 2008. In Postojna cave two TM 71 extensometers, 260 m apart, are installed at the same fault zone, which extends about 1 km north from the Dinaric oriented (NW-SE) Predjama Fault. Since 2004 to the present small tectonic movements are detected, dextral horizontal movement of -0.05 mm for Postojna 1 and extension of -0.03 mm for Postojna 2. But the highest peaks can be of 0.08 mm. Preliminary results in Polog cave, where TM 71 is placed in the vicinity of 1998 (Mw=5.6) and 2004 (Mw=5.2) earthquakes on the Ravne Fault, show -0.08 mm of extension between two limestone beds (from October 2008 to March 2009). From March to May 2009 the movement on *x*-axis returned back to -0.02 mm. The highest trend in Kostanjevica cave was detected as vertical movement along *z*-axis for +0.035 mm from June 2008 to May 2009, representing subsidence of the NW block and uplift of SE block. In all three studied caves the data obtained by TM 71 monitoring are related to

354