ENGLISH VERSION

Thursday evening:

<u>Public lecture</u>: "From the ocean to the Alps: history of the Cogne magnetite mineralization"

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Abstract

The magnetite deposit of Cogne was mined until 1979 and produced a high-quality iron ore suitable for making special steels that were comparable to the Swedish ones. However, the genesis of the Cogne magnetite, which is different from any other known magnetite mineralizations worldwide both for its geological and geochemical characteristics, remained unknown for long time.

In 1981 new geologic, petrologic, geochemical and ore-mineral data indicated a hydrothermal origin for the Cogne magnetite. The formation of such deposits was considered to be related to serpentinisation of mantle peridotite that had been exhumed at the floor of the Tethys ocean. The subsequent discovery of relict cores of chromite within the magnetite mineralizations of the nearby ultramafic rocks of Monte Avic (in a somewhat similar setting to the Cogne deposit) suggested that, at least locally, magnetite formed at the expenses of chromitite lenses within the ultramafics. This is explained more generally in the following paragraphs.

Over the last 20 years, studies along the margins of the Atlantic Ocean have provided new and important insight into the formation of these magnetite deposits. Off the coasts of France and Spain, scientists found large areas where the ocean floor is made of up a dark green rock known as serpentinite. The presence of such rocks on the ocean floor is attributed to the progressive thinning of the continental crust during the divergence of the European and North American tectonic plates beginning at about 210-220 Ma ago, just before the opening of the North Atlantic ocean. As a consequence of this divergence, silicate rocks rich in magnesium and iron (so-called ultramafic rocks or peridotites) that originated in the Earth's mantle at a depth of at least 30 km were progressively exhumed, that is, they were lifted upward from beneath the Earth's crust that was actively thinning due to the activity of extensional faults. These faults were zones of intensive rock deformation that served as conduits for fluids that flow both downward from the ocean, and upward from Earth's mantle.

The Cogne magnetite deposit may therefore have formed along an extensional fault in a process known as serpentinisation that leads to the formation of a rock (serpentinite) containing mostly the mineral serpentine. Serpentinisation occurs when hot, dry rocks of Earth's mantle (peridotites) come into contact with cold sea water. This process started about 160 Ma ago when the Tethyan Ocean opened during southeastward motion of the African Plate away from the European Plate, a divergent motion that was linked to the opening of the North Atlantic already mentioned above.

The preservation of such large-scale extensional structures despite the overprinting effects of later deformation that is related to the formation of the Alps starting about 70 Ma ago is one of the most recent discoveries of Alpine geology. The study of such structures in nature is made possible by the high quality of the Cogne rock exposures. This allows us to improve our understanding of the geodynamic processes that lead to the opening of oceans and the formation of this type of ore deposit.

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Diella V., Ferrario A., Rossetti P. (1994): The magnetite ore deposits of the Southern Aosta Valley: chromitite transformed during an alpine metamorphic event. *Ofioliti***,** 19, 247-256.