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Magnetic fabrics and paleomagnetism of the Stephanian pyroclastic and volcanic deposits in the Castejón-Laspaúles basin (Central Pyrenees). New insights on the flow directions and basin geometry

Esther Izquierdo Llavall (1), Antonio Casas Sainz (1), and Belén Oliva Urcia (2)

(1) University of Zaragoza, Ciencias de la Tierra, Zaragoza, Spain (estheriz@unizar.es), (2) Geo-environmental Processes and Global Change, IPE-CSIC, Zaragoza, Spain

The anisotropy of magnetic susceptibility (AMS) in volcanic and pyroclastic rocks has been widely used for the determination of flow patterns, and becomes specially useful in massive deposits where kinematic markers are scarce. Paleomagnetic techniques allow to quantify the vertical axis rotation the rocks have undergone since their formation, when the analyzed samples carry a primary magnetization. The combination of both methodologies is a powerful tool to reconstruct volcanic and pyroclastic flow directions in defomed, rotated domains and to constrain the location of the volcanic source. The present study shows the results obtained from the application of this methodological approach to the Stephanian volcanic and pyroclastic deposits of the Castejón-Laspaúles sub-basin, located in the southern margin of the Pyrenean Axial Zone (Central Pyrenees). This basin was strongly inverted and forelandward rotated during Alpine thrusting, but mesoscopic cleavage was not developed in the sampled units.

Samples for the AMS and paleomagnetic study were collected in 9 sites distributed throughout the basin. Measurements of the magnetic fabric were made at room and low temperature (∼77ºK) with a KLY-3S susceptibility meter that combined with a CS-3 furnace and a CLS apparatus was also used to perform temperature-dependent susceptibility curves. Stepwise thermal and alternating field (AF) demagnetization of the natural remanent magnetization (NRM) were carried out using a 2-G Cryogenic.

The bulk magnetic susceptibility (Km) of the samples ranges between 117 and 415·10-6 S.I. in all but one of the sites, where an anomalously high value of Km (1080·10-6 S.I.) was obtained. Temperature-dependent susceptibility curves indicate an hetereogeneous mixure of paramagnetic and ferromagnetic phases, mainly magnetite. The contribution of both phases is consistent with the bulk magnetic susceptibility values at low temperature that range between 1.7 and 2.9 times the Km measured at room temperature. The axes of the magnetic susceptibility ellipsoid at low and room temperature overlap, suggesting that the orientation of paramagnetic minerals and magnetite coincide.

Different types of magnetic susceptibility ellipsoids have been obtained. In general terms, K3 is perpendicular to the bedding or flow plane, in a well-defined cluster or forming a girdle with K2, and K1 is contained within the bedding or flow plane. After tectonic correction, K1 shows a N-S preferred strike for both pyroclastic and volcanic samples. The reliability of the AMS was tested by means of image analysis methods. The results indicate that the AMS closely approximates the shape preferred orientation of the different fragments and minerals forming the deposits. The paleomagnetic study reveals the existence of a primary component showing an average clockwise rotation of 26º with regard to the Stephanian reference direction. The restitution of this clockwise vertical axis rotation, modifies slightly the orientation of K1 axes to a preferred NNW-SSE strike, suggesting that volcanic and pyroclasctic emissions were controlled by ENE-WSW-striking, deep faults limiting the basin towards North and South.