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Tectonically controlled magnetic fabrics in the Iberian Triassic basin

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A relationship between the orientation of the magnetic susceptibility ellipsoid and the strain ellipsoid has been demonstrated by using the anisotropy of magnetic susceptibility (AMS) in sedimentary rocks. Studies also interpret an early development of the magnetic fabric, which registers the stress pattern acting during deposition. But this primary fabric can be overwritten by successive deformation phases, and these changes have been registered even in weakly deformed sediments.
This work studies the AMS registered in an inverted basin where no penetrative compression-related structures have been recognized. Although inversion took place, strata remain weakly deformed, with shallow dips in most part of the area.
Triassic sedimentary rocks from the Castilian Branch of the Iberian Range (NE Spain) are studied. The Castilian Branch started to develop as a rift basin during the Late Permian-Early Triassic with NW-SE and NE-SW faults affecting Upper Permian materials. Buntsandstein red beds accumulated in asymmetric half-grabens with strong thickness variations related to their position within the troughs and highs. After the Mid-Triassic, a marine and transitional sedimentation spanned throughout the Iberian Range (Keuper and Muschelkalk). Jurassic to Upper Cretaceous deposits unconformably covered the Triassic sediments with thickness of a few hundreds of meters. During the Paleogene, tectonic inversion took place, developing gentle folds and steeply-dipping reverse faults, resulting from the reactivation of extensional Triassic faults. The particular lithology of the Buntsandstein red beds also allows determining the influence of ferromagnetic phases in the AMS.
We analyzed 815 standard specimens from 55 sites in a KLY-3S Kappabridge (AGICO) susceptometer to obtain the bulk susceptibility and the orientation of the three main eigenvectors of the magnetic ellipsoid. In order to determine the magnetic carriers of the bulk susceptibility, 22 temperature dependent susceptibility curves (from 40 to 700ºC) were carried out, combining the susceptometer with a CS-3 furnace. Sites are representative of all the red beds sectors from the Castilian Branch, limited by different extensional structures acting during Triassic rifting.
The magnetic susceptibility ranges between 80 and 350 x 10-6 SI. Most of the thermomagnetic curves indicate the presence of a high fraction of hematite as ferromagnetic mineral. In other cases, hematite and phyllosilicates are present in the same proportion, usually coinciding with samples from sites with the lowest susceptibility values. In some cases neoformation of magnetite takes place during heating.
Results show kmin always subperpendicular to the bedding plane, according to a sedimentary fabric. kmax indicates four main directions for the magnetic lineation: NW-SE, NNE-SSW and, less represented N-S and E-W. These variations in lineation directions are directly related to several tectonic events, and can be interpreted according to i) the direction of the major extensional structures nearest to each site (suggesting an extensional-influenced origin for the lineation), ii) the geographic position of the basin sectors, depending on their proximity to the inverted faults (that would suggest a partial tectonically-influenced secondary magnetic fabric), iii) the age of the studied rocks, suggesting a stronger influence of extensional features in Early Triassic rocks, progressively diminishing upwards within the sedimentary sequence.