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Tectonic and kinematics of curved orogenic systems: insights from AMS analysis and paleomagnetism

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During the past few years, paleomagnetism has been considered a unique tool for constraining kinematic models of curved orogenic systems, because of its great potential in quantifying vertical axis rotations and in discriminating between primary and secondary (orocline s.l.) arcs. In fact, based on the spatio-temporal relationships between deformation and vertical axis rotation, curved orogens can be subdivided as primary or secondary (oroclines s.l.), if they formed respectively in a self-similar manner without undergoing important variations in their original curved shape or if their curvature in map-view is the result of a bending about a vertical axis of rotation. In addition to the kinematics of the arc and the timing of its curvature, a crucial factor for understanding the origin of belts curvature is the knowledge of the geodynamic process governing arc formation. In this context, the detailed reconstruction of the rotational history is mainly based on paleomagnetic and structural analyses (fold axes, kinematic indicators), which include the magnetic fabric. In fact, in curved fold and thrust belts, assuming that the magnetic lineation is tectonically originated and formed during layer-parallel shortening (LPS) before vertical axis rotations, the orientation of the magnetic lineation often strictly follows the curvature of the orogeny. This assumption represents a fundamental prerequisite to fully understand the origin of orogenic arcs and to unravel the geodynamic processes responsible for their curvature.
We present two case studies: the central Mediterranean arcs and the Alborz Mts in Iran. The Mediterranean area has represented an attractive region to apply paleomagnetic analysis, as it shows a large number of narrow arcs, whose present-day shape has been driven by the space-time evolution of the Mediterranean subduction system, which define a irregular and rather diffuse plate boundary. The Alborz Mts. form a sinuous range over 1,200 km long, defining from west to east a salient with a southward concavity which results in the wrapping of the South Caspian basin to the north, and a southward reentrant with apex which encircles the Central Iranian block to the south. The integration of paleomagnetic and AMS data indicates that this orogen started to form as an almost straight E-W oriented range and acquired its present-day curved shape by means of opposite vertical axis rotations. Such a process was probably caused by the relative motion between different rigid blocks (South Caspian, Central Iran, and the Eastern Iranian Blocks) forming the collision zone and hence must be a crustal to lithospheric-scale process.