

Estero Cono, Southern Chile: The Development of a Tectonic Controlled Basin by Migrating Pivot Rotations

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We carried standard paleomagnetic sampling at 17 sites including clastic sediments (7 sites), feeder dikes (4 sites), pillow lavas and massive lava flows (6 sites) from the Chile Margin Unit (CMU) located in the northernmost edge of the Taitao Ophiolite in southern Chile. Although CMU deposits may seem to represent the volcani-clastic cover of the ophiolite, they do not belong to it. Instead, they represent the evolution and infilling of a tectonic basin, namely Estero Cono basin, generated by the obduction tectonics experienced by the ophiolite for the last ca. 6-3 My time.

The CMU volcani-clastic sequence is composed of: (1) pillow lavas, (2) clastic sediments and (3) massive basaltic lava flows and pillow lavas, all with a total thickness of about 3000 m. The sequence is intruded by several NW-SE trending basaltic dikes which are the feeding conduits of pillow lavas and lava flows on top of the sequence. Such feeder dikes are parallel to the general trending of normal brittle faults which disrupt the continuity of the volcani-clastic deposits. The contacts of CMU are not clearly established but they seem to correspond to erosional and angular unconformities with the dike complex unit of the ophiolite to the south, and with the Pre-Jurassic metamorphic basement to the north.

Alternating field demagnetization technique was used to isolate remanent magnetic (RM) vectors from each one of the 283 available paleomagnetic specimens, which were later grouped by sampled site. Isolated RM vectors per specimen are univectorial with no affection of secondary magnetizations except for a small viscous magnetic component usually erased with a peak field of ca. 20-30 mT. Orientation of RM vectors does not coincide with the orientation of the expected geomagnetic axial dipole (GAD) for the area; also they show elliptical distributions at site level. These observations suggest that counterclockwise rotations about inclined rotational axes affected the different blocks that compose the volcani-clastic sequence.

We computed the rotational axes which restore directly the mean RM vector at each site to the orientation of the expected GAD. Rotational axes were analyzed at site and lithological levels. At site level, rotational axes are consistently NE to E-ward inclined mostly, with counterclockwise associated rotations and showing an increasing rotational amount towards the westernmost edge of the basin. On the other hand, at lithology level rotational axes show an increasing inclination as well as a decreasing rotational amount towards east of the basin.

The spatial distribution of rotational axes and the characteristics of their related rotational amounts can be explained by a moving pivot model in which the pivot represents the point where the rotation of the block containing the deposits occurs. At first, deposits located at the westernmost edge of the (not yet developed) basin started to rotate about an almost vertically oriented rotational axis located eastward from that location. As the counterclockwise rotation continued the location of the pivot migrated westward, resulting in the rotation of the block containing deposits located between the actual pivoting location and the western edge of the basin. As a consequence, the almost vertically oriented rotational axis recorded by RM vectors during the first pivot rotation was inclined towards NE direction. As the eastward migration of the pivot continued, it produced the opening and developing of the Estero Cono basin.

The almost vertical orientation of the youngest rotational axis and the eastward inclination of older rotational axes suggest that the pivoting migrating process as well as the opening of the basin were controlled by the activity of a transpressional dextral fault zone. Such fault zone developed in the bottom of the basin with an increasing extensional component towards west.