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SIGNIFICADO TECTONICO DE LOS ESTUDIOS PALEOMAGNETICOS EN LOS ANDES

TECTONIC SIGNIFICANCE OF PALEOMAGNETIC STUDIES IN THE ANDES

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Paleomagnetic studies of Andean rocks are relatively rare, but enough are available to show several interesting patterns. Results of five recent studies on rocks of Cretaceous age are shown in Fig. 1. From Fig. 1 it is clear that there is a distinct difference between

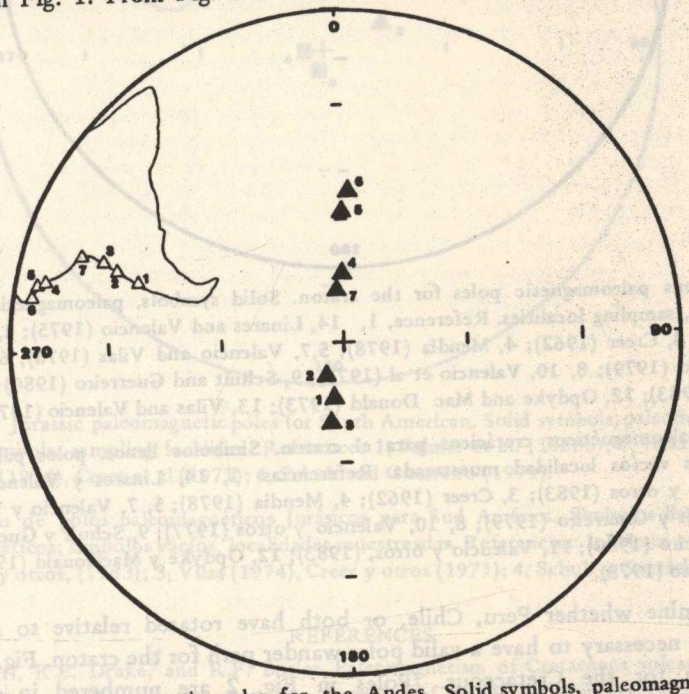

Fig.1. Cretaceous paleomagnetic poles for the Andes. Solid symbols, paleomagnetic poles; open symbols. sampling sites. Reference: 1, Beck et al. (in press): 2, Palmer et al (1980a); 3, Turner et al (1984); 4, May and Butler (1985); 5, 6, 7, Heki et al (1983, 1984).

Fig.1. Polos paleomagnéticos Cretácicos para los Andes. Simbolos llenos, polos paleomagnéticos; simbolos vacios, sitios de muestreo. Referencias: 1, Beck y otros, (en prensa); 2, Palmer y otros, (1980a); 3, Turner y otros (1984); 4, May y Butler (1985); 5, 6, 7, Heki y otros (1983-1984).

rocks from Chile and rocks from Peru. Regardless of reference pole (that is, regardless of where the Cretaceous paleomagnetic pole for stable South America may happen to lie), it is obvious from Fig. 1 that Cretaceous rocks in Peru have been rotated counterclockwise roughly 30-40°, relative to rocks of the same age in Chile. This is in the same sense as the change in trend of the coastline and various other linear geographic features that is encountered in passing northward from Chile into Peru (the Arica deflection). The data summarized in Fig. 1 have been seen by some authors as evidence that the Arica deflection is an orocline.

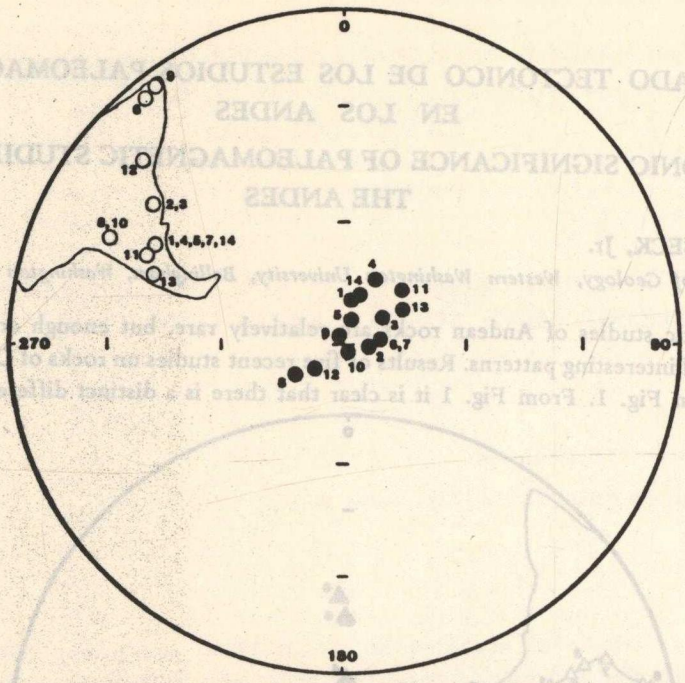

Fig.2. Cretaceous paleomagnetic poles for the craton. Solid symbols, paleomagnetic poles; open symbols, sampling localities. Reference, 1, 14, Linares and Valencio (1975); 2, Bellieni et al. (1983); 3, Creer (1962); 4, Mendia (1978); 5,7, Valencio and Vilas (1976); 6, Schult and Guerreiro (1979); 8, 10, Valencio et al (1977); 9, Schult and Guerreiro (1980); 11, Valencio et al. (1983); 12, Opdyke and Mac Donald (1973); 13, Vilas and Valencio (1978).

Fig.2. Polos paleomagnéticos cretácicos para el craton. Simbolos llenos, polos paleomagnéticos; simbolos vacíos localidad muestreada. Referencias: 1, 14, Linares y Valencio (1975); 2, Bellieni y otros (1983); 3, Creer (1962); 4, Mendia (1978); 5, 7, Valencio y Vilas (1976); 6, Schult y Guerreiro (1979); 8, 10, Valencio y otros (1977); 9, Schult y Guerreiro (1980); y Guerreiro (1980); 11, Valencio y otros, (1983); 12, Opdyke y MacDonald (1973); 13, Vilas y Valencio (1978).

To determine whether Peru, Chile, or both have rotated relative to stable South America it is necessary to have a valid polar wander path for the craton. Fig. 2 illustrates the situation for the Cretaceous. (Poles in Fig. 2 are numbered in approximate chronological order, from oldest (1) to youngest (14)). Although some of these studies involve rocks from the eastern foothills of the Andes, and thus may be affected by thrust-sheet rotation, many are from areas that have been tectonically stable since the Cretaceous. The curious "streaked" pattern obvious in Fig. 2 is probably significant, but its meaning is not obvious. It is clear from Fig. 2, however, that the precise interpretation placed on any Cretaceous pole from the Andes will depend very critically upon its age.

There are very few reliable paleomagnetic results from the Cordillera for any time period other than the Cretaceous. Fig. 3 shows two recent Jurassic pole positions, together with appropriate reference poles for the craton. From Fig. 3 it appears that Jurassic rocks in northern Chile also have been rotated counterclockwise.

Paleomagnetism is a very promising tool for the study of Andean tectonics. A great

deal of excellent work already has been done on the craton by paleomagnetists from Argentina and Brazil. However, before paleomagnetics can be utilized efficiently, a great many more well-dated rock units must be studied, on the craton as well as in the orogen.

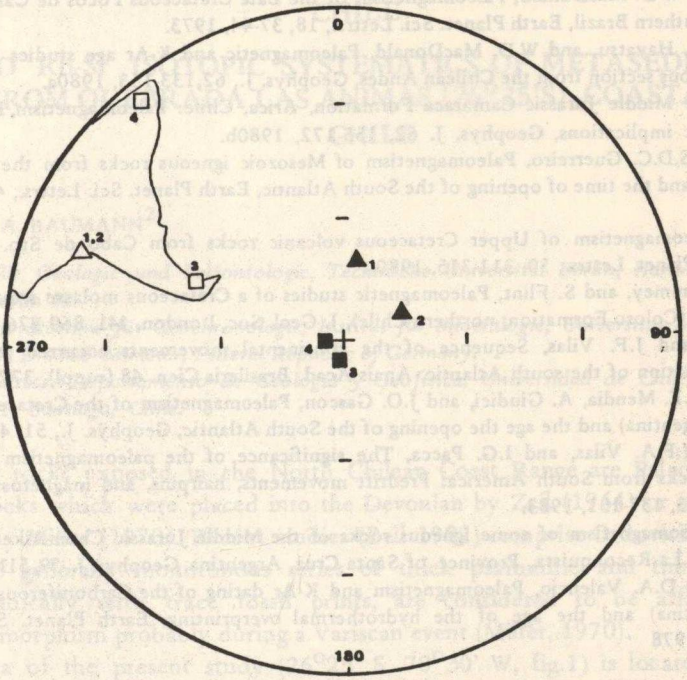

Fig.3. Selected Jurassic paleomagnetic poles for South American. Solid symbols, paleomagnetic poles; open symbols, sampling localities. Reference: 1, Palmer et al. (1980b); 2, Heki et al. (1983); 3, Vilas (1974), Creer et al (1971); 4, Schult and Guerreiro (1979).

Fig.3. Selección de polos paleomagnéticos Jurásicos para Sud América. Simbolos llenos, polos paleomagnéticos; simbolos vacíos, localidades muestreadas. Referencias: 1, Palmer y otros (1980b); 2, Keki y otros, (1983); 3, Vilas (1974), Creer y otros (1971); 4, Schult y Guerreiro (1979).

REFERENCES

Beck, M.E., Jr., R.E. Drake, and R.F. Butler, Paleomagnetism of Cretaceous volcanic rocks from central Chile, and some comments on the tectonics of the Andes, Geology (in press).

Bellieni, G., P. Brotzu, P. Comin-Chiaramonti, M. Ernesto, A F. Melfi, I.G. Pacca, E.M. Picirillo and D. Stolfa, Petrological and paleomagnetic data on the plateau basalt to rhyolite sequences of the southern Parana basin (Brazil), Anais Acad. Brasileria Cien. 55, 355-383, 1983.

Creer, K.M., Paleomagnetism of the Serra Geral Formation, Geophys, J., 7, 1-22, 1962.

Creer, K.M., J.G. Mitchell, and J. Abou Deeb, Paleomagnetism and radiometric age of the Jurassic Chon Aike Formation from Santa Cruz Province, Argentina: Implications for the opening of the South Atlantic, Earth Planet. Sci. Lettrs., 14, 131-138, 1972.

Heki, K., Y. Hamano, and M. Kono, Rotation of the Peruvian block from paleomagnetic studies of the central Andes, Nature, 305, 514-516, 1983.

Heki, K., Y. Hamano, H. Kinoshita, A. Taira, and M. Kono, Paleomagnetic study of Cretaceous rocks of Peru, South America: Evidence for rotation of the Andes, Tectonophysics, 108, 267-281, 1984.

Linares, E., and D.A. Valencio, Paleomagnetism and K-Ar ages of some trachybasaltic dikes from Rio de los Molinos, Province of Cordoba, Republica Argentina, J. Geophys. Res., 80, 3315-3321, 1975.

May. S.R and R.E. Butler, Paleomagnetism of the Puente Piedra Formation, central Peru, Earth Planet. Sci. Lettrs., 72, 205-218, 1985.

Mendia, J.E., Paleomagnetic study of alkaline vulcanites from Almafuerte, Provincia of Cordoba, Argentina, Geophys. J., 54, 539-546, 1978.

Opdyke, N., and W D. MacDonald, Paleomagnetism of the Late Cretaceous Pocos de Caldas Alkaline Complex, southern Brazil, Earth Planet. Sci. Lettrs., 18, 37-44, 1973.

Palmer, H.C., A. Hayatsu, and W.D. MacDonald, Paleomagnetic and K-Ar age studies of a 6 km.-thick Cretaceous section from the Chilean Andes, Geophys. J., 62,133-153, 1980a.

————, The Middle Jurassic Camaraca Formation, Arica, Chile: Paleomagnetism, K-Ar age dating and tectonic implications, Geophys. J. 62, 155-172, 1980b.

Schult, A., and S.D.C. Guerreiro, Paleomagnetism of Mesozoic igneous rocks from the Maranahao basin, Brazil, and the time of opening of the South Atlantic, Earth Planet. Sci. Lettrs., 42, 427-436, 1979.

————, Paleomagnetism of Upper Cretaceous volcanic rocks from Cabo de Sto. Agostinho, Brazil, Earth Planet. Lettrs., 50, 311-315, 1980.

Turner, P.,H. Clemmey, and S. Flint, Paleomagnetic studies of a Cretaceous molasse sequence in the central Andes (Coloso Formation, northern Chile), J. Geol. Soc. London, 141, 869-876, 1984.

Valencio, D.A. and J.F. Vilas, Sequence of the continental movements occurred prior to and after the formation of the south Atlantic, Anais Acad. Brasileria Cien. 48 (suppl), 377-386, 1976.

Valencio, D.A., J.E. Mendia, A. Giudici, and J.O. Gascon, Paleomagnetism of the Cretaceous Pirgua Subgroup (Argentina) and the age the opening of the South Atlantic, Geophys. J., 51, 47-58, 1977.

Valencio, D.A., J.F.A. Vilas, and I.G. Pacca, The significance of the paleomagnetism of Jurassic Cretaceous rocks from South America: Predrift movements, hairpins, and magnetostratigraphy, Geophys. J., 73, 137-151, 1983.

Vilas, J.F.A., Paleomagnetism of some igneous rocks of the Middle Jurassic Chon-Aike Formation from Estancia La Reconquista, Province of Santa Cruz, Argentina, Geophys. J., 39, 511-522, 1974,

Vilas, J.F.A., and D.A. Valencio, Paleomagnetism and K-Ar dating of the Carboniferous Andacollo Series (Argentina) and the age of the hydrothermal overprinting, Earth Planet. Sci. Lettrs, 40, 101-106, 1978