

UNA COMPARACION DE LA EVOLUCION MAGMATICA MESOZOICA DE LOS ANDES DE ATACAMA Y MAGALLANES

MESOZOIC ANDEAN MAGMATIC EVOLUTION OF THE ATACAMA AND MAGALLANES ANDES, CHILE: A COMPARISON

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The meso-cenozoic evolution of the Andes, known as the Andean Evolution, is that of a magmatic arc related to eastward subduction of Pacific lithosphere under Paleozoic forearc terranes. The geology of the southernmost Andes has been usually compared with that of the Antarctic Peninsula, but rarely with other segments of the Andes. In this paper a review of Mesozoic magmatic evolution of the Andes of Atacama and Magallanes is presented and compared. This comparison shows that their evolution can be subdivided in major stages of the same type but with substantial dissimilarities. These variations are basically in the timing and intensity of the processes, and in the different paths followed during the late evolutionary stages during the Upper Cretaceous and younger times.

The Andes of Atacama

The initial stages of the Andean history in this area started during the Upper Triassic according to the record of stratified rocks (e.g. NARANJO et al., 1982). However, a first examination of the geochronology of the plutonic rocks of this region (e.g. BERG et al., 1983, NARANJO & PUIG, 1985) does not allow the identification of the beginning of the Andean cycle. These radiometric dates are distributed throughout the Paleozoic - Triassic boundary, but no information is given in the literature on whether they represent crystallization or reset ages. Although, a petrogenetic difference between Paleozoic and Mesozoic granitoids has been reported, the older granitoids being S-type and the younger I-type (BERG et al., 1983). The boundary between these different granitoids is given, however, at 200 Ma by BERG et al., (1983), synchronously with Liassic andesitic volcanism (SUAREZ et al., 1982). The Upper Triassic paleogeography was characterized by volcanoes of intermediate character and an abrupt relief, probably related to extensional tectonism (CHARRIER, 1979).

Consequently, the initial stages of the Andean Evolution in Atacama were characterized by extensional tectonism, intermediate volcanism suggestive of subduction and S-type granitoids.

During Jurassic-Early Cretaceous times the volcanic activity which started during the Upper Triassic continued with the development of an arc-back-arc basin system with the widest distribution of the volcanic deposits occurring during the Bajocian (NARANJO, et al., 1982, NARANJO and PUIG, 1985). The emplacement of I-type granitoids (BERG

et al., 1983) at about 190 Ma, recently identified in the coastal ranges of the region by NARANJO et al., (in prep), confirms previous assumptions of Lower Jurassic plutonism in the area (e.g. DAMM and PICHOWIAK, 1981). The spatial and temporal coincidence of this plutonic belt with Liassic volcanism (SUAREZ et al., 1982) suggests the possibility of a genetic link between them. Shallow marine sediments, mainly calcareous, were deposited in back-arc and intra-arc basins during the Jurassic.

An eastward shift of Jurassic to Cenozoic plutonism and volcanism with time has been reported since ZENTILLI's (1974) work (COIRA et al., 1982). Early faulting along the Atacama Fault Zone occurred during the emplacement of granitoids dated at about 130 Ma (NARANJO et al., 1984).

During the Upper Jurassic-Lower Cretaceous a regression took place in the pre-Cordillera of Atacama (GARCIA, 1967). Upper Jurassic-Lower Cretaceous regressive sequences are widespread in Chile and have been discontinuously recognized for about 1300 km long from latitude 21°30' to 35° S (MAKSAEV, 1981, CHARRIER, 1981). The wide extent of this regression suggests a tectonic control, probably uplift of the continent along the eastern part of the region.

During a mid-Cretaceous tectonic event the marine back-arc basin disappeared and from that period onwards the main constituent of the Andean edifice are eastward migrating continental arcs (COIRA et al., 1982). This tectonic event was mainly an epeirogenic one, being the main compressive phase of Late Cretaceous-Tertiary age.

The Andes of Magallanes

The initial stages of the Andean history in this area are characterized by extensional tectonism and acid volcanism of Middle-Upper Jurassic age. At least part of these silicic volcanic rocks have been interpreted as generated by anatexis of continental crust (BRUHN et al., 1979). S-type granitoids of Upper Jurassic age (157 Ma), exposed in Cordillera Darwin, may represent the roots of this volcanism (HERVE et al., 1981). Along the Pacific margin of the Cordillera, I-type granitoids and gabbros were being emplaced (HERVE et al., 1984). Andesitic to rhyolitic volcanic rocks of Upper Jurassic-Lower Cretaceous age could have started to form during this stage. The latter, the I-type granitoids and the gabbros suggest the participation of subduction processes during this period.

During the Late Jurassic-Early Cretaceous, a back-arc basin with a partly mafic floor developed; it is also seen in South Georgia (e.g. DALZIEL et al., 1974, SUAREZ and PETTIGREW, 1976). The beginning of the evolution of this basin was related to rifting and was later filled by arc-derived volcanoclastic turbidites while thermal subsidence was going on. Synchronously to the evolution of this arc, gabbros and some granitoids were emplaced (HERVE et al., 1984, SUAREZ et al., 1985).

During mid-Cretaceous times (~ 100 Ma), the back-arc assemblages were strongly deformed and uplifted due to the closure of the basin (BRUHN and DALZIEL, 1977, HERVE et al., 1984). Marine conditions continued towards the Atlantic side of this proto-cordillera (Magallanes Basin), and rapid subsidence occurred in this basin during the mid-Cretaceous due to loading related to this new orographic element. Turbidites were deposited during the Upper Cretaceous in this basin.

Comparison between Andes of Atacama vs Andes of Magallanes

The main differences in the evolution of these two segments of the Andes are:

- timing: in Atacama the beginning of the Andean history is in the Late Triassic, whilst in Magallanes it is in the Middle-Late Jurassic.
- while during the Late Jurassic-Early Cretaceous a back-arc basin was being formed in Magallanes a widespread regression was taking place in northern Chile.
- marine conditions continued during the Late Cretaceous in Magallanes whereas they disappeared during that period in Atacama.
- the southernmost arc system is distinguished from the northern one by the oceanic affinities of parts of the basin floor (“ophiolites”). Therefore, in the south the continental crust was ruptured and a basin with ocean-floor characteristics was formed, while to the north (north of Lat. 49° S) the continental crust was thinned without actual rupture.
- deformation of the back-arc assemblages was stronger in the south.
- the back-arc basins in Atacama were shallower than the basin in Magallanes

Finally, a general decrease in initial $^{87}\text{Sr}/^{86}\text{Sr}$ with time as that identified in both segments of the Andes has also been recognized in the Antarctic Peninsula (PANKHURST, 1982). Therefore, this must have been controlled by a major process. The explanation given to the S-type of magmatism in Atacama as the product of continental collision (DAMM and PICHOWIAK, 1981) should be abandoned, because a collision along that length of the southwestern margin of Gondwana would have left more clear fingerprints.

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