GEODYNAMIC EVOLUTION OF THE PALAEOZOIC GONDWANA MARGIN IN WESTERN ARGENTINA (FAMATINA-SYSTEM)

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RESUMEN

Los caracteres geoquímicos de los basaltos ordovicícos del Sistema de Famatina (SF) son comparables a los de basaltos calcoalcalinos modernos de arcos de islas oceánicos. Observaciones sedimentológicas prueban la existencia de una cuenca de retroarco entre el arco volcánico (SF) al oeste y el craton (Sierras Pampeanas) al este en el Ordovicíco (relacionado a coordenadas actuales). Durante la colisíon del arco con el continente se intruyeron granitoides anatécticos corticales en el SF (Orogénesis Famatiniana). Como indicadores de un estadio poscolisional aparecen leucogranitos peralcalinos (Devonico?). En el mismo ambiente geotectónico del SF se intruyeron basaltos de subducción. Los caracteres geoquímicos de estos basaltos corresponden a los de basaltos calcoalcalinos de un borde continental activo como del actual tipo Chile.

KEY WORDS: Famatina-System, island arc - back arc, collision, magmatism

INTRODUCTION

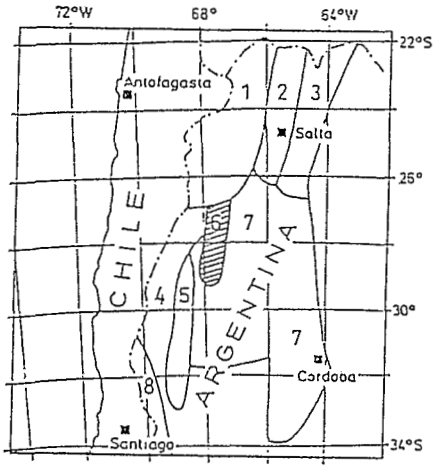

Fig.1: Morphostructural units in NW-Argentina. Puna (1), Cordillera Oriental (2), Sierras Subandinas (3), Cord. Frontal (4), Precordillera (5), Famatina-System (6), Sierras Pampeanas (7), Cord. Principal (8).

The Famatina System (FS) represents a lithostratigraphically and structurally independent unit within the NW-argentinian Sierras (fig.1). It is characterized by Lower to Middle Ordovician volcanosedimentary sequences, which are intruded by calcalkaline granitoids of Upper Ordovician to Devonian age and by syn- to postplutonic volcanic dykes. According to Aceñolaza and Toselli (1984) and Toselli et al. (1991) the magmatic characteristics of the FS advocate for a destructiv plate margin. In the concept of Willner et al. (1987) and Rapela et al. (1990) the Ordovician western Gondwana margin included a volcanic arc in the region of the FS and a several hundred km large zone of intrusion situated in the back of the arc. Dalla Salda et al. (1992 a,b) suggest an Ordovician collision between Laurentia and Gondwana, which lead to the Famatina Orogenesis.

GEOCHEMICAL AND SEDIMENTOLOGICAL ARGUMENTS

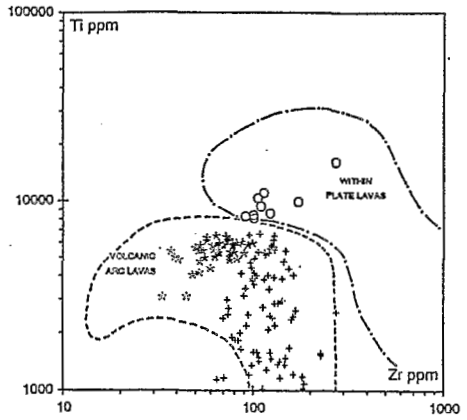

Fig.2: Intermediate to acid (+) and basic (o,*) volcanic rocks in the Ti vs. Zr diagram after Pearce (1982).

The Ordovician synsedimentary and discordant basic to acidic volcanics show congruent geochemical properties and are interpreted as calcalkaline magmas of a magmatic arc. In contrast, a younger generation (Devonian?) of discordant basic dykes reveals typical intraplate characteristics (fig.2).

The Ordovician basalts exhibit typical island arc patterns in MORB-normalized spider diagrams. Analogues patterns are known from modern oceanic island arcs (e.g. Mariana or Java arc, see Pearce 1983, fig.3).
The presence of a back arc basin located between the volcanic arc and the continent in the area of the FS is documented by the intimate association of olisthostromes, rich in volcaniclastic material, derived from the island arc, and distal cratonal turbidites. Intercalated calcareous turbidites are supposed to be introduced from a carbonate platform situated on the continent-ward side of the basin (Clemens 1992, Mannheim and Clemens 1992).

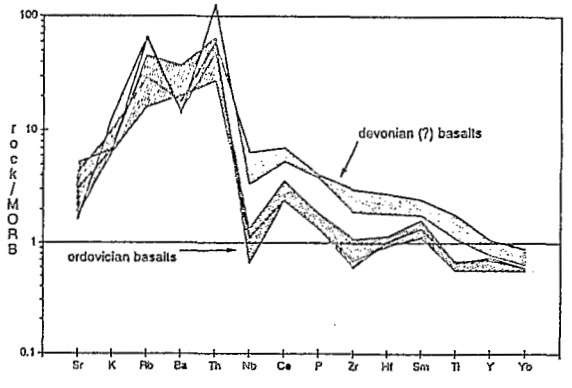

Fig.3: MORB-normalized spider diagrams of the famatinian basalts

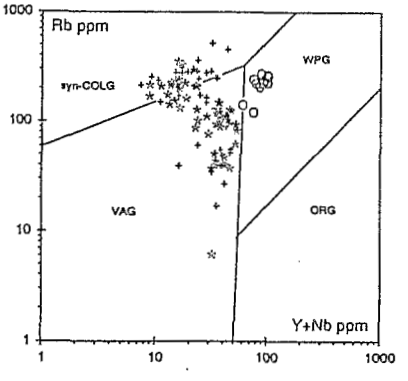

Fig.4: Intermediate and acid volcanic rocks in the Rb vs. (Y+Nb)-diagram after Pearce (1984).
Ordovician volc. (+,*), Devonian (?) leucogranites (o)

The intermediate to acid volcanics of the Ordovician show geochemical characteristics of an island arc in a compressional environment with clear syncollisional affinities (fig.4). They are not directly related by differentiation processes to the basic magmas, but are generated by crustal melting and magma mixing (Mannheim 1993).

Peralcaline A-type leucogranites (Devonian?) represent the late orogenic to postcollisional stage of the FS (fig.4). Subduction-related basalts generated by partial melting of a subcontinental mantle enriched by metasomatic processes intruded this geotectonic scenario. Calcalkaline basalts of the modern continental margin in central Chile exhibit similar patterns (fig.3, compare Pearce 1983).

CONCLUSONS

During the Cambrian the western edge of Gondwana changes from a passive to an active continental margin. This is reported by a subduction-related I-type magmatism in the Pampean Range, wich commenced in the Middle Cambrian (Lottner 1986, Willner et al. 1987, see fig.5 a).

In the Lower Ordovician a marginal basin opened due to mantle convection creating an extensional environment, and the initial arc developed to a rifted arc. In the Pampean Range (remnant arc) the I-type magmatism ceased as a result of the westward shift of the subduction zone. According to Rapela et al. (1990) the Lower Ordovician calcalkaline plutonic bodies intruded the "inner back arc" zone.
The FS represents the ocean-wards drifting part of the magmatic arc. Primary basic magmas were generated in a "depleted", purely oceanic mantle environment. From Tremadocian to Llanvirnian the basin received sediments from the continent and from the island arc (fig.5 b). In the FS the volcanic arc and the adjacent part of the back arc basin are actually exposed. The continent-ward part of the basin (carbonate platform?) has been probably overriden during the postordovician accretion of the island arc to the continent.

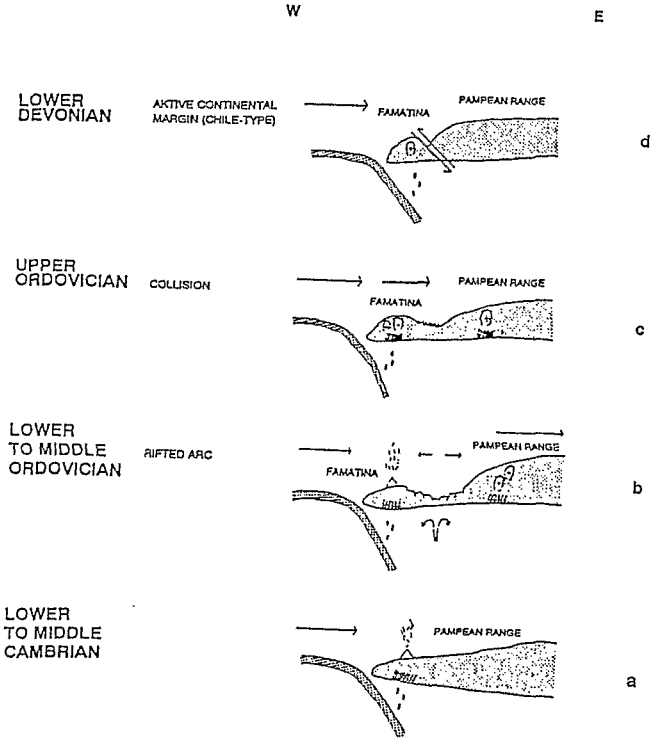

Fig.5: Geodynamic evolution of the Famatina-System in the Palaeozic

The closure of this short-lived marginal basin started in the Middle Ordovician. At the Ordovician/Silurian boundary large amounts of peraluminous collisional granitic melts intruded the FS (fig.5 c).

Probably in the Lower Devonian the island arc - continent collision was concluded, the FS was accreated to western Gondwana. The incessant subduction lead to the intrusion of basaltic magmas generated in a metasomatically enriched mantle. The "collision-thickened" active continental margin was intruded by late to postorogenic leucogranites indicating the extinction of the Famatinian Orogenesis (fig.5 d).

Similar Lower Palaeozoic back arc basins are described by Bahlburg (1990) for the Puna region situated north of the FS and by Loske (1992 a,b) for the Precordillera in the south (compare fig.1).

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