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Emplacement levels of the Coastal Batholith in Central Peru

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Introduction

A Late Jurassic - Cretaceous succession composed of volcanic, volcanoclastic, siliciclastic and carbonate strata, which was deposited in an ensialic marginal basin (Atherton et al., 1985; Atherton & Webb, 1989; Aguirre et al., 1989), crops out in the present-day central Peruvian coastal area, along two belts parallel to the Andean trend. Between these outcrop belts, this succession is heavily intruded by km- to m-size sills of granitoid rocks, which as a whole form the Coastal Batholith.

Lithostratigraphic units in the marginal basin

Southeast of Lima, the Upper Jurassic (Tithonian), ~700m-thick, Pucusana Formation consists of volcanic and volcanosedimentary strata; it includes an upper shale-dominated member (Quipa Member; Bosc, 1963). North of Lima, its equivalent is the Upper Jurassic (Tithonian), ≥1700 m-thick, volcanosedimentary and volcanic Puente Piedra Group, which includes the shale-dominated Puente Inga member (Rivera et al., 1975; Alemán et al., 2004).

This volcano-sedimentary succession is overlain by a Valanginian siliciclastic unit, the Morro Solar Group, that was deposited in a deltaic front, and includes a shale-dominated middle member (the La Virgen member; Fernández-Concha, 1958). Carbonate strata of Hauterivian-Aptian age occur at the top of this siliciclastic unit, and display basinal-slope facies (Pamplona Formation) and high-energy barrier facies (Atocongo Formation) (Rivera et al., 1975).

The ~3000 m-thick Albian-Cenomanian Casma Group consists of andesite flows interbedded with sandstones (greywackes), shales and pyroclastics (Guevara, 1980; Atherton & Webb, 1989; Soler, 1991; Jacay et al., 2003). In particular, the Casma Group comprises a lower succession consisting of mudstones and shales interstratified with volcano-sedimentary turbidites, intercalated between volcanic members. In the upper part of its middle section, olistolites composed of volcano-sedimentary and carbonates materials are observed. The Upper Casma Group consists of thick units of volcanic agglomerates and debris-flow; locally known as the Huarangal and Quilmana members, the Upper Casma Group grades to the east into fine-grained slope facies and volcanoclastic distal turbidites (Yangas Formation).

To the southeast, a Jurassic succession displays large-scale facies ranging from turbidites to tidal environment, and includes fine-grained basinal and slope facies in the Omas Valley sector (Asia Formation). Between the Chillon and Rimac valleys, fine-grained basinal and slope facies laterally grade into a large carbonate platform of Late Cretaceous age (Arahuay Formation).

Levels of emplacement of granitoid sills

In central Peru, the emplacement of the Coastal Batholit mainly took place between the Albian and Maastrichtian (Cobbing et al., 1981; Mukasa 1986). It is noteworthy that the corresponding magmas were intruded as sills or megasills into a number of dominantly fine-grained levels of the stratigraphic succession: The shale-dominated Quipa, Puente Inga, and La Virgen members appear as "interstratified" with sills of basaltic andesites and tonalites and gabbros. Plutonic rocks of the Tiabaya Superunit intrude the black shales of the Asia Formation. Black marls of the Pamplona Formation and a shale member at the base of the Yangas Formation are intruded by plutons of the Santa Rosa Superunit (Corralillo unit). Monzonite sills of the Pacho Superunit intrude the fine-grained levels of the Arahuay Formation. Similar relationships between Coastal Batholith plutons and host rocks are observed in the Moche valley, where granitoid sills intrude black shales within the Casma Group.

Most Coastal Batholith plutons appear as sets of tabular bodies that vary in thickness. Individual sills commonly display compositions that grade from mafic at the base to felsic at the top. Swarms of basaltic and granitic sills are observed, preferentially showing NE-SW orientations in lower levels and NNW-SSE orientations in upper levels, and indicating extensional directions that are compatible with the formation of the Casma-age marginal basin.

In the south, between the Yauca and Cháparra valleys, granite sills intrude Jurassic dark shales and turbidites (Guaneros Formation). Northeast of Tacna, a dioritic (base) to granitic (top) tabular pluton intrudes the Middle Jurassic San Francisco Formation, which was deposited in a deep-water environment (Pino et al., 2004).

Conclusion

It appears that intrusions of the granitoid sills that mainly compose the Coastal Batholith preferentially occurred in shaly stratigraphic units. Characteristically, the units that display the highest frequence of granitoid sills are the shale-dominated Yangas, Arahuay, Pamplona, and Asia formations.

Sill thicknesses decrease to the west, where stratigraphic levels of sill emplacement are less numerous. Conversely, sill thicknesses increase to the east, where levels of emplacement are more numerous. Sills emplaced into Jurassic levels are more western and correspond to porphyric andesites and diorites, whereas those emplaced into Cretaceous levels are granodioritic, tonalitic and granitic.

It is noteworthy that the main epoch of granitoid (sill) emplacement in the west, namely 110-60 Ma, was largely coeval with the development in the east of a Late Cretaceous - Paleogene red-beds basin fed from the west, strongly suggesting that magmatism in the west participated in the contemporaneous crustal thickening and relief formation (proto-Andes).

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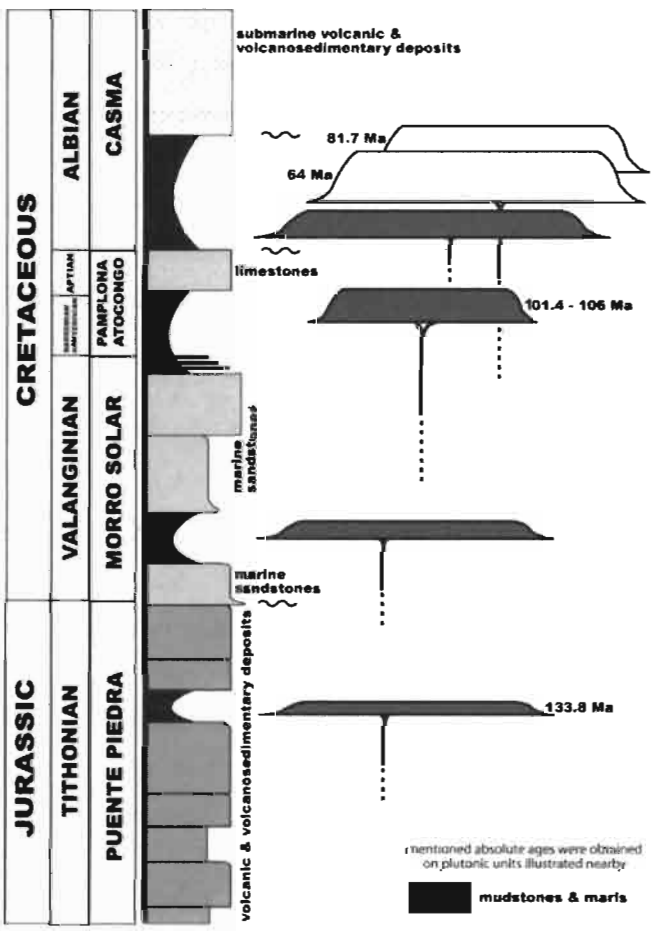

Figre 1 : Schematic Jurassic-Cretaceous stratigraphic succession in coastal central Peru and levels of emplacement of the main tabular bodies composing the Coastal Batholith.