STRATIGRAPHY, SEDIMENTOLOGY AND TECTONIC EVOLUTION OF THE RIO CAÑETE BASIN : CENTRAL COASTAL RANGES OF PERU

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ABSTRACT

The Rio Cañete Basin in the Central Coastal Ranges of Peru (C.C.R.P.) represents a fault-bounded frontal-arc Late Jurasic (Tithonian) to Albian sequence formed by aborted intra-arc spreading process during the early evolution of the Andes (Fig.1). The sequence, exposed in the Lima area, consists of more than 6000 meters of volcaniclastic sedimentary rocks, lava flows, lime mudstones, shales, quartz rich sandstones and subordinated fossiliferous limestones and evaporites. The stratigraphy records several episodes of volcanism and extension along and across the basin and provides new insight in the evolution and crustal growth of the Central Andes.

INTRODUCTION

Four widespread groups and one areally restricted formation mark important stages in the stratigraphic, sedimentologic and tectonic evolution of the Rio Cañete Basin. The Puente Piedra Group consists of volcaniclastic debris, basaltic to andesitic lava flows, shales and subordinate limestones that document the presence of a Jurassic volcanic arc (Fig.2). The overlying quartz rich sandstones and shales of the Morro Solar Group (fig.3) records an abrupt change in sedimentation and tectonic style. Ensialic extension accompanied by subsidence of the volcanic arc and concomitant uplift of the Paleozoic to Precambrian "Coastal Cordillera" (Paracas Block) explains the change of source and provenance. The areally restricted Pucusana Formation (Fig.4), made up of alkaline lavas, volcanic breccias and lapillistones, is interpreted to represent a localized volcanic center perhaps related to subduction of oceanic fractures. Above the Morro Solar is the Lima Group (fig.5) consisting mainly of lime mudstone, shale, gypsum and bioclastic limestone that represent the maximum pulse of the Neocomian transgression. Spatial and temporal volcanism took place along and across the basin coeval with this shale-limestone sequence, reflecting early pulses of volcanic activity related to the emplacement of the Coastal Batholith of Peru. The widespread nature of the volcanic activity is recorded in the overlying Chillon Group (Casma Group) which represents volcanism (Fig.6) coeval with the early emplacement of Albian gabbros and diorites of the Coastal Batholith. Extension was coeval with volcanism as documented by the presence of quartz rich sandstones in this group.

BASIN EVOLUTION

The Rio Cañete Basin was formed at least as early as the Late Jurassic with the deposition of the arc-derived Puente Piedra Group. Ensialic extension concurrent with arc volcanism played a paramount role in the evolution of the Andes at least since Late Triassic when an arc trench setting was established (James, 1971; Cobbing, 1978; Atherton et al, 1983, 1985). Narrow, elongated, fault-bounded basins were perhaps formed in response to embryonic ensialic back arc spreading in similar way to the mechanism described by Levi and Aguirre (1981) and Veragara et al (1995) in central Chile and Petford and Atherton (1995) in central Peru. Integration of stratigraphic and sedimentologic information in the Rio Cañete Basin have allowed the recognition of several stages during its evolution.

STAGE I.- The early stage in the evolution of the Rio Cañete Basin was initiated with the formation of the Jurassic volcanic arc and deposition of the Puente Piedra Group derived largely from arc activity. Deposition took place in a narrow elongate basin, as documented by Cobbing (1978), formed by extensional processes related to embryonic back-arc spreading. Both effusive and explosive volcanism alternated throughout deposition of this group with several periods of volcanic quiescence as it is recorded in several shale sequences (Fig.2). These shale/volcaniclastic sequences are interpreted to represent relative small transgressive-regressive cycles within an overall global sea level rise.

STAGE II.- During the Late Berriasian, a new period of ensialic extension (Atherton, 1983, 1985) took place along the Western Peruvian Trough as documented by the abrupt change in source terrane from an arc derived to a continental block suite. This new episode of extension was probably related to changes in the rate of plate motion in the south American plate and changes in the angle of subduction as it is documented by cessation in volcanism. Extension was probably episodic and contemporaneous with sedimentation and perhaps accounts for the uplift of Paleozoic or Precambrian rocks. Partial subsidence of the Jurassic arc and its roots was concomitant with deposition of quartz rich sandstones of the Salto del Fraile Group. The positive nature of these older rocks is documented in the west and northwest by the continuation offshore of the Coastal Cordillera which makes up he Paracas Block (Myers, 1975), also known as the Outer Shelf High.

STAGE III .- In this stage, the uplifted Paleozoic or Precambrian terranes were submerged during a global rise of sea level. This was accompanied by a change in deposition from a quartz-rich sandstone facies to a limestone-shale facies with significant to moderate volcanic contributions along and across the basin (Lima Group). Some of the submerged Paleozoic highs may have played a very important role in restricting the circulation and communication of the basin with the open ocean, therefore, increasing the likelihood of evaporite precipitation within the basin. Deposition of a shale-limestone sequence alternating with perverse arc volcanism varied in space and time along and across the basin and may have been associated to third order global sea level changes and early phases of cauldron subsidence and gabro intrusions of the Coastal Batholith. Furthermore, variation in volcanic activity in these formations along the basin might also be related to segmentation of the Coastal Batholith which accounts for temporal and spatial variations in plutonic activity in time and space (Cobbing et al, 1977). Subduction of deep crustal fractures, in the same way as envisioned by De Long et al (1975), might account for the localized and odd nature of the volcaniclastic, alkaline lava flows of the Pucusana Formation.

STAGE IV.- Embryonic back-arc extension persisted throughout the Middle Albian with deposition of the volcanic derived Chillon Group. This group represents the maximum paroxysm of volcanic activity associated with the early emplacement of the Coastal Batholith (Cobbing, 1978). Renewed pulses of extension, contemporaneous with the Chillon Group, might have exposed the sandstones of the Morro Solar Group as it is documented in some of the quartz-rich beds found in the lower part of the Chillon Group in the Perico Hill. Widespread subaqueous volcanic activity in the Chillon Group is correlated with the gabbro to gabbrodiorite plutonic intrusions (Patap Super-unit) and cauldron subsidence of the Coastal Batholith of Peru (Pitcher and Cobbing, 1985).

STAGE V.- Extension was interrupted at the end of the Middle Albian by a short-lived compressional event related to the initial stages of the Andean Orogeny (Mochica Phase). North of Lima, in the Huarmey Basin, where this phase is relatively well expressed, the Casma Group (equivalent to the Chillon Group) has been folded following a NW-SE trend subparallel to parallel to the Coastal Batholith (Webb, 1976; Child, 1976). The folds are open, upright and parallel, rarely showing a slight SW vergence (Guevara, 1980). This orogenic phase is expressed with variable intensity in the Western Peruvian Trough and may be linked to different rates of subduction along the arc-trench system.

STAGE VI.- Soon after the Mochica Phase of the Andean Orogeny, the frontal-arc basin rocks were uplifted due to pervasive underplating along the roots of a long-lived arc. Indeed, deep seated plutonic rocks of the Coastal Batholith were emplaced along the Rio Cañete Basin and provided the roots for isostatic uplift.

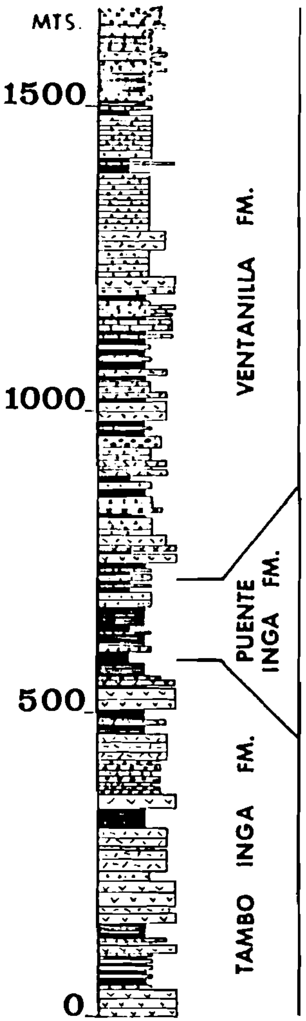

Fig.2

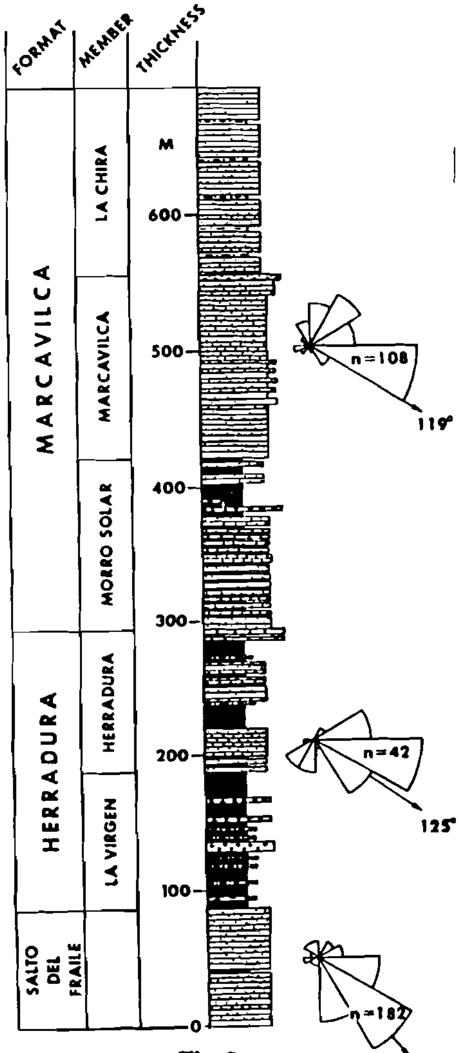

Fig.3

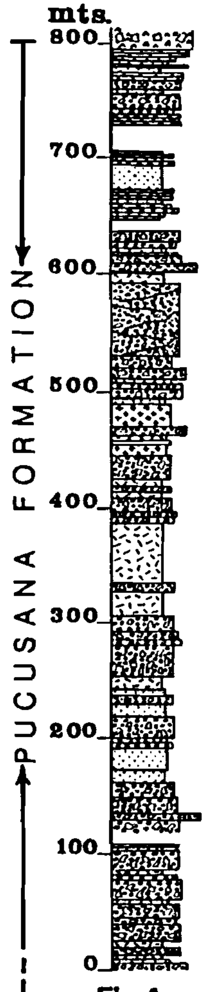

Fig.4

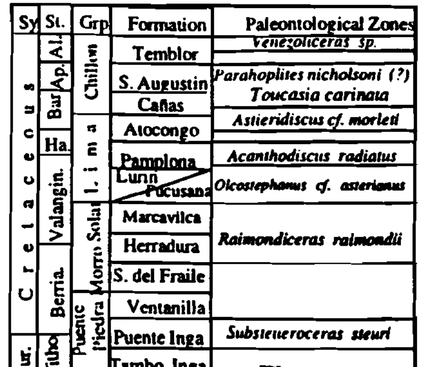

Fig.1

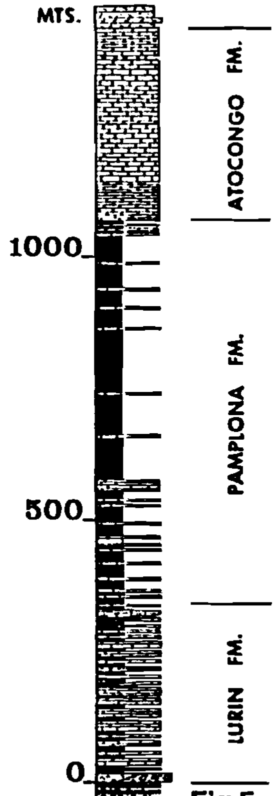

Fig.5

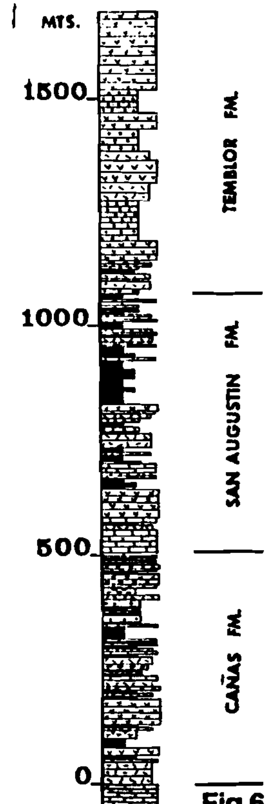

Fig.6

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