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EVOLUTION OF THE COASTAL RELIEFS OF SOUTHERN PERU (*LOMAS*) AS SUGGESTED BY THE SOIL-LANDFORM RELATIONSHIPS: A CASE STUDY FROM MEJÌA SITE (DEPARTMENT OF AREQUIPA)

ABSTRACT: CALDERONI G., LAZZAROTTO L., RODOLFI G. & TERRIBILE F., *Evolution of the coastal reliefs of southern Peru (lomas) as suggested by the soil-landform relationships: a case study from Mejìa site (Department of Arequipa)*. (IT ISSN 0391-9838, 2002).

The Peruvian coast along with a major portion of the Chilean coast constitute a continuous desert belt which extends in latitude for about 3500 km. In this area we have some of the minimum world based annual rainfall values, ranging from 5 mm in Northern Peru (Chiclayo) to 0.6 mm in Chile at Arica (Rauh, 1983).
The mean temperatures are similar to the ones characterising other intertropical zones; at Callao they range from 16.9°C in September to 21.6°C in March, with minimal variations changing with latitude.
Such climatic homogeneity depends both on (i) the specific morpho-structural situation characterised by a long chain of smooth hilly reliefs (*lomas*) parallel to the coast and on (ii) the presence of a cold oceanic stream (Humboldt stream) which moves northwards along the coast. This climatic homogeneity is abruptly suspended, approximately every 10 years, when there is an inversion in the oceanic circulation («*ENSO - El Niño Southern Oscillation*»).
It therefore changes as soon as one moves from the coast towards the inner continent. From May through October the combined action of these factors produces a continuous dense layer of fog from 400 to 1000 m a.s.l. which is continuously supplied by the oceanic waters.
As it has been observed that as the fog moves inland it spontaneously condensates into water at the troposphere pedosphere interface, efforts have been focused on enhancing this process in order to utilize the fog as an effective water supply for the hyper-arid local environment.
In particular, within the framework of an INCO/UE project coordinated by Università di Firenze (*Fog as a new water resource in Southern Peru and Northern Chile*) the main goal was to utilize the condensation water to restore the discontinuos forest cover («fog oases») which, according to Ellemberg (1959) in the past used to extend along the 400-1000 m a.s.l. hilly belt facing the ocean.
For this purpose, in 1996, an experimental station was set up in a representative environment of Las Cuchillas, in the nearby of Mejìa (district of Arequipa).
Within the framework of this project, the authors objective was to characterise the soil-landscape relationships in a large area around the experimental station, the aim being to produce a soil-landscape model to be extrapolated in other comparable coastal Peruvian environments.
In the preliminary stage, the use of Landsat and airborne images enabled the authors to divide the area into 5 soil-landform units which, moving in a direction perpendicular to the coast, outcrop in succession up to an altitude of 1000 m a.s.l. The soil survey carried out in the *lomas* unit, which included the experimental station, showed a very specific situation, never reported as yet. The field and analytical data, as well as the ^{14}C dating of the 2Abss horizon of the compound geosol (*Vertic Paleargid*), which is widespread in the area, allowed for the reconstruction of the following major stages in the environmental and geomorphologic evolution of this coastal portion of Peru:

I. first soil formation stage on the crystalline rocks, reflecting a period of tectonic stability. the occurrence of a dense plant cover is strongly suggested by a buried Btb horizon, rich in Fe, pointing to moist conditions;
II. first severe erosion stage due to either (i) new tectonic activity or (ii) long period of aridity producing a sharp morphology with V shaped valleys and boulder heaps on summits;
III. deposition of a thick ash layer, probably the onset of Holocene (Thouret & *alii*, 1999) by nearby volcanic activity;
IV. weathering of the above mentioned ash layer resulting in the formation of a geosol, the 2ABtss horizon of which has been dated between 4530 and 1870 years BP;
V. second erosive stage, implying both the truncation of the geosol and the formation of thick colluvial deposits on the valley bottom;
VI. emplacement of a thin whitish level of volcanic ash, continuously spread all over the area by the Huaynaputina volcano (attributed to the 1600 A.D. event, according to historical sources);
VII. soil formation processes on the above mentioned tephra, still in progress though at low rate because of the unfavourable climatic conditions;
VIII. third erosive stage (underway at present), especially active during the «ENSO events». In some instances the effects of the latter combined with deforestation and overgrazing in increasing soil erosion up to the point of exposing the crystalline bedrocks, causing mass movements and originating rills and gullies.In some instances the effects of the latter combined with deforestation and overgrazing in increasing soil erosion up to the point of exposing the crystalline bedrocks, causing mass movements and originating rills and gullies.

The conclusion reached is that the present virtual lack of rainfall does not conflict with the observed advanced soil development in that the pedogenesis of the lower volcanic ash level could have occurred during a phase of humid climate. In turn, the former tree and bush cover probably disappeared because of the anthropogenic impact and its relics could have survived in the present arid conditions by uptaking enough water from the seasonal fog. In contrast with the common belief of an overall homogeneity of the soil cover along the S. Peruvian coast the results of the geomorphological and pedological investigations herein reported support a rather complex origin and differentiation.

KEY WORDS: Southern Peru, Arequipa, Coastal desert, *Lomas*, Soillandform
units.

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