

PALEOCLIMATE OF THE LOWER PINTURAS FORMATION, MIDDLE MIOCENE, SANTA CRUZ PROVINCE, ARGENTINA

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The Pinturas Formation (middle Miocene) is a pyro-epiclastic unit cropping out in the NW Santa Cruz Province. Three sequences separated by unconformities were originally described by Bown and Larriestra (1990) as constituting this unit. Here we present the study of paleosols developed within the lower sequence of the Pinturas Formation from two localities (Sumich Norte –SN– and Estancia Ana María –AM–), providing both a reinterpretation of the original stratigraphic scheme, and new paleopedologic data for acquiring a reliable paleoclimatic scenario.

The First Sequence, up to 11 m-thick, is equivalent to the lowermost part of the lower sequence of Bown and Larriestra (1990), being characterized by “very mature paleosols”. It is composed of pyroclastic sandstones and mudstones, and intraformational conglomerates, over which pinkish brown paleosols developed. Paleosols represent a unique type of soil, herein referred as “pinkish paleosol” (color of the matrix 5Y8/4), which is composed of two horizons. The B horizon crops out as an indurated cornice, with beds showing tabular to lenticular geometry. It is constituted by either a tuffaceous sandstone or an intraformational conglomerate with subangular to subrounded clasts immersed within a tuffaceous sandy matrix. Tractive structures are absent, and a coarse stratification is occasionally recognized. Well-developed pedogenic features in the outcrops include: medium-scale cuneiform, blocky and granular peds; polygonal cracks to the top of the horizon; irregular pinkish mottles (5YR7/2); clay coatings; rhizoliths, and insect trace-fossils. Clay coatings and mottles are also present on microscopic scale. Geochemical analyses determined Al₂O₃/bases ratios of 1.1–7.3, Ba/Sr ratios of 0.4–0.9, and CIA-K values of 57.4–91.9. The C horizon consists of a massive, tuffaceous, very fine- to fine-grained sandstone, locally with intraclasts of precedent B horizons at the base. Pedogenic features are mostly absent; however, the contact is transitional. The lowermost C horizon in the sequence coincides with the base of the Pinturas Formation at SN, and displays an irregular basal surface that has up to 7–9 m in relief.

The Second Sequence coincides with the “sandy yellow, green or pink bentonitic mudstone” of Bown and Larriestra (1990) recognized at SN. It is composed of fine- to medium-grained sandstone, yellowish grey (5Y8/2) in color. Tractive structures are not recognized. The base of the sequence is represented by an irregular surface, interpreted as a valley scour that has up to 15 m in relief. Within this new sequence, a second type of paleosol is recognized, herein referred as “yellowish paleosol”. The B horizon displays irregular, pinkish brown mottles (5YR7/2), frequent rhizoliths (1–2 mm in diameter), and occasionally poor-developed granular structure. *Coprinisphaera* and *Feoichnus* are common. Geochemical analyses determined Al₂O₃/bases ratios of 1.16, Ba/Sr ratios of 1.4, and CIA-K values ~ 61. The C horizon is characterized by a massive sandstone with uncommon pinkish mottles near the contact with the B horizon.

The “lower sequence” of Bown and Larriestra (1990) is defined in more detail and divided in two unconformity-bounded sequences. The lowermost is characterized by moderate to strongly-developed paleosols formed under seasonal, temperate and humid/subhumid climates (MAT: 11–16°C; MAP: 680–1350 mm/year). The Second Sequence is characterized by weakly to moderately-developed paleosols, formed under seasonal, temperate and subhumid climates (MAT: ~11°C; MAP: 740 mm/year). Both stratigraphic order and features from the pinkish and yellowish paleosols suggest a paleoclimatic change toward relative drier conditions and an increase in the sedimentary rate. Higher MAP-MAT values recognized in the lower sequence, along with the age of these deposits, suggest a close relationship with the mid-Miocene climatic optimum, a period in which global temperatures were warmer at mid-high latitudes.

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Bown, T.M. y Larriestra, C.N., 1990. Sedimentary paleoenvironments of fossil platyrrhine localities, Miocene Pinturas Formation, Santa Cruz Province, Argentina. *Journal of Human Evolution* 19: 87-119.