



Cenozoic landscape evolution of the hyperarid core of the Atacama Desert

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The Atacama Desert of northern Chile is one of the driest places on Earth, with an extreme hyperarid core (Coastal Cordillera & Central Depression between 19° and 22°S), receiving less than 2 mm/yr modern precipitation. Subtropical atmospheric subsidence and the temperature inversion due to coastal upwelling of cold waters of the Peru-Chile Current have led to hyperarid conditions. The Andes Mountains to the east cast a rain shadow over the Atacama Desert as moisture originating from the Atlantic becomes orographically elevated, causing precipitation on the eastern Andean flank and a relative absence westwards. While the main factors controlling hyperaridity in the Atacama Desert are established, most of these were operational/present throughout the Neogene, the onset and permanence of hyperaridity remain a matter of debate.

The long-term aridity of the hyperarid core of the Atacama created a unique landscape that on a large scale is dominantly modified by tectonic forces. Traces of fluvial and aeolian modifications are more subtle; in many areas they are virtually absent. The subtle changes in the colluvium, the incision and deposition can be used to determine the rate of modification and/or their timing. Useful tools to decipher these records are cosmogenic & radiogenic nuclides and luminescence dating. From the data of past and ongoing studies it emerges that the present hyperarid core of the Atacama has been predominantly (hyper-) arid since the Early Miocene, possibly since the Oligocene. This background (hyper-) aridity, however, was interrupted by wetter phases (probably still 'arid' in a climatological sense) causing limited surface modifications. In the hyperarid core these traces of fluvial activity may be preserved for millions of years.

The apparent contradiction between these findings and other, much younger, estimates for the onset/duration of (hyper-) aridity can be reconciled by taking the regional distribution of the studies in to consideration. South of the hyperarid core winter-rainfall, with a Pacific moisture source, dominates. This area has experienced a dynamic geomorphological response to Quaternary climate change. Offshore records indicate that position of the Winter-rain-dominated region may have shifted up to 2 degrees northwards during stadials in the Quaternary. Ephemeral and perennial rivers with headwaters in the Pre-Cordillera or Altiplano, and areas above 2000 m, also respond readily to Quaternary climate. Evidence for a recent (Pliocene) onset of aridity is mostly sourced from areas south of and/or at higher elevations than the hyperarid core delineated above.

