

Composition of Soils and Ground Waters at the Pampa del Tamarugal, Chile: Anatomy of a Fossil Geochemical Anomaly Derived from a Distant Porphyry Copper Deposit

MATTHEW I. LEYBOURNE[†]

Ocean Exploration, GNS Science, Box 30-368, Lower Hutt, New Zealand

AND EION M. CAMERON

Eion Cameron Geochemical Inc., 865 Spruce Ridge Road, Carp, Ontario, Canada K0A 1L0

Abstract

The Pampa del Tamarugal in northern Chile is a gravel plain, part of the hyperarid Atacama desert. Soil geochemical surveys over the pampa using partial extraction analyses identified a large, >100-km² geochemical anomaly for Cu. Subsequent analyses showed unusually high concentrations of elements that are associated with copper porphyry deposits, Mo, As, and Se. The soils are saline (NaCl) and contain high concentrations of Br and I, which are abundant in ground waters from northern Chile. The anomaly lies west of one of the world's most important copper porphyry districts, which includes the Chuquicamata, Radomiro Tomic, and El Abra deposits. Follow-up drilling in the center of the anomaly, through ~300 m of piedmont gravel cover, revealed barren andesitic basement rocks.

The soil anomalies were caused by ground water reaching the surface, then evaporating. Both ground waters and soils share a common element assemblage, with higher concentrations of Mo, As, and Se than Cu. The former dissolve as anions in ground water, which can travel far from their source, whereas dispersion of Cu²⁺ is restricted by adsorption. The soil anomaly is interpreted to be a "fossil" anomaly, preserved by the hyperarid climate. To the south the anomaly is cut by an alluvial fan; another nearby fan has been dated at ~7 Ma. To the west the anomaly was eroded in the flood plain of the Rio Loa. Prior to the present ~50-m-deep incision of the Rio Loa, the water table in the area of the anomaly may have been higher than the present depth of 33 to 55 m, facilitating capillary rise of water to the surface. We suggest that the source for the anomaly was the El Abra deposit, 75 km east and updrainage from the anomaly.

[†] Corresponding author: e-mail, m.leybourne@gns.cri.nz