PREFACE / PREFACIO

Paleosols and ancient societies: from early humans to the industrial revolution

Paleosoles y sociedades antiguas: desde los primeros humanos hasta la revolución industrial

Georgina **Ibarra-Arzave**[1], Elizabeth **Solleiro-Rebolledo**[2], Maria **Bronnikova**[3,4]

[1] Ecosystem and Sustainability Research Institute, National Autonomous University of Mexico, Antigua Carretera a Pátzcuaro 8701, 58190, Morelia, Michoacán, Mexico.

[2] Institute of Geology, National Autonomous University of Mexico, Av. Universidad no. 3000, 04510, Coyoacán, CDMX, Mexico.

[3] Institute of Geography, Russian Academy of Sciences, Staromonetnyy Pereulok 29, 119017, Moscow, Russia.

[4] New Mexico State University, 1536 Standley Drive, Las Cruces, NM 88001, USA.

* Corresponding author: (G. Ibarra-Arzave)
gigiotes81@yahoo.com.mx

How to cite this preface:
Ibarra-Arzave, G., Solleiro-Rebolledo, E., Bronnikova, M., 2022, Paleosols and ancient societies: from early humans to the industrial revolution: Boletín de la Sociedad Geológica Mexicana, 74 (3), P021122. http://dx.doi.org/10.18268/BSGM2022v74n3p021122

Peer Reviewing under the responsibility of Universidad Nacional Autónoma de México.

PREFACE

Paleopedology, the study of soils developed on ancient landscapes (Yaalon, 1971), was born in Russia through the efforts of Boris B. Polynov (1927), but considering the previous work done by Vasilli V. Dokuchaev in 1883 (Dokuchaev, 1967) and later with the support of Constantin C. Nikiforoff (1943). The Commission on Paleopedology was established in 1965, in Denver, USA, by Dan Yaalon and Hans van Baren (Retallack, 2013) during the 7th Congress of the International Association for Quaternary Research (INQUA) and later, in 1968, the Commission was affiliated to the International Union of Soil Science (IUSS). After the Denver conference, the Commission published a volume with research papers focused on the recognition and classification of paleosols, methods of dating, and soil stratigraphy (Yaalon, 1971). This volume was the beginning of an extensive series of the Commission publications in different special issues of international and national scientific media. Two of these collections were published in open-access Mexican geological journals: *Revista Mexicana de Ciencias Geológicas* v. 20 no. 3 (2003) and v. 21 no. 1 (2004), and *Boletín de la Sociedad Geológica Mexicana*, v. 64 no. 1 and 64 no. 2 (2012). The current issue is a continuation of this series.

There are two concepts necessary for understanding paleosols. The first is the use of the uniformitarian principle, which suggests that past geologic processes are similar to those acting today on the Earth's surface. In other words, the basis of modern soil geography and soil genesis is used as directly analogous to reconstruct ancient environments and landscapes. This approach is more precise when applied to Quaternary paleosols and more limited to pre-Cambrian or Paleozoic paleosols, as the environmental conditions under which they were formed are pretty different from the modern ones (Retallack, 2001). The second concept is "soil memory" (Targulian and Goriachkin, 2004), related to a set of properties that can remember ancient environmental conditions. These properties result from pedogenetic processes and soil-forming factors and are time-resistant to environmental changes remaining stable during extended periods (Targulian and Goriachkin, 2004).

In recent years, paleopedology has extended its applications to reconstruct past climates, establish variations in the atmospheric composition, trace the ecosystem evolution, and identify geomorphological changes (e.g., Cerling, 1991; Retallack, 1998, 2009; Goudi, 1990; Klinge *et al.*, 2022). Some efforts have also been made to develop models to quantify pedogenetic trends associated with environmental change (e.g., Yaalon, 1975; Sheldon and Tabor, 2009). An essential application of paleopedology has been devoted to solving archaeological problems, as soils can be considered repositories of human activities: agriculture, forestry, material for construction or ceramic production, dwelling and householding (Holliday, 2009; Costa *et al.*, 2021; Yalçın *et al.*, 2021).

The impact of past anthropogenic activities has been recorded in the soil memory through time: since the first hunter and gatherers groups to the industrial societies. However, the relationship between humans and their environment (and vice versa) is complex and demands the application of different methodologies and the study of in-site and off-site approaches (Butzer, 2008), which integrates the information directly recovered in the archaeological excavation and that from the surrounding areas. In this sense, the paleosol-archaeological investigation has a more solid interpretation.

In June 2021, the Paleopedology Commission of the IUSS, the Paleopedology Working Group of the INQUA, and the Institute of Geology of the UNAM organized a three-day online meeting with scientific sessions. The meeting topics related to the link between paleosols, the history of human interactions, and the environment. This special issue was launched as a result of this meeting. The articles included here aim to improve our understanding of the materials used for ancient constructions also past human interactions with the environment.

Five contributions are related to ancient construction materials and come from study cases done in Germany, and Mexico. First, Kurgaeva *et al.,* investigated earthwork construction in a semi-circular fortification rampart around Hedeby, a former Viking settlement, which was an important international, early medieval trading center. On the other hand, three cases of earth architecture from Mexico are included in the issue. Pre-Hispanic and colonial adobes found in several buildings were characterized chemically and mineralogically by Puy-Alquiza *et al.*, using a multimethodological approach to identify the manufacturing techniques. Similarly, Daneels *et al.*, studied earthen structure architecture in three Mesoamerican archaeological sites to understand the construction techniques through micromorphological observations. Finally, García-Zeferino *et al.,* characterized several earthen structures in one Mesoamerican archaeological site, La Joya, Veracruz, comparing them with the neighboring soils to determine the provenance of the materials used in the constructions.

Seven study cases are presented in this special issue concerning human-environinetal interractions, soil forming, sedimantary and diagenic processes in archaeological contexts. One case is from Africa, two from Peru, one from Colombia, one from Mexico, and one from Kazakhstan. In Equatorial Guinea, Cruz-y-Cruz *et al.*, studied a Middle Stone Age site with a paleopedological approach to establish how humans inhabited the tropical forest. Santana-Quispe *et al.,* provided evidence of environmental degradation, strong sedimentation, and erosion processes through modifying agents, such as water and wind, in the Lower Ica Valley, Peru (c. AD 900–1550). Also, in Peru, Marie-Agnès Courty analyzed the effects of environmental events on living conditions during the late Holocene occupation periods in the Moche valley (North Peruvian coast). In contrast, Triana-Vega and Pérez-Crespo identified possible environmental variations and plant availability throughout the occupation of two archaeological sites: Tequendama and Aguazuque, located in Sabana de Bogotá, Colombia.

Bronnikova *et al.*, studied cultural layers in different environmental conditions in Russia and Kazakhstan to evaluate the anthropogenic impact using micromorphology as the primary tool.

Nevertheless, Martínez-Pabello *et al.*, studied desert varnishes in Mexico to understand the relationship between lithodiversity and the petroglyphs carved on rocks of different compositions, identifying a higher contribution of the aeolian sediments to the varnish coating. Dorison *et al.,* analyzed the agricultural lands in Mesoamerica using lidar visualizations, modeling, and satellite images to detect anthropogenic and geopedologic features. Finally, the work of Gavrilov *et al.*, studied building materials and technics applied for the Scythian burial mounds construction, buried paleosols and their diagenesis in the North of Kazakstan. This last paper is a contribution in memoriam as the late Denis A. Gavrilov passed away during the COVID pandemic.

http://dx.doi.org/10.18268/BSGM2022v74n3p021122

References

Butzer, K.W., 2008, Challenges for a cross-disciplinary geoarchaeology: The intersection between environmental history and geomorphology: Geomorphology, 101, 402-411. https://doi.org/10.1016/j.geomorph.2008.07.007

Cerling, T.E., 1991, Carbon dioxide in the atmosphere: evidence from Cenozoic and Mesozoic paleosols: American Journal of Science, 291, 377–400. https://doi.org/10.2475/ajs.291.4.377

Costa, S., Purdue, L., Dufour, A., Charbonnier, J., 2021, An oasis soil reference collection for the identification and study of ancient cultivated soils in arid environments (Oasis of Masafi, United Arab Emirates): Geoarchaeology 36, 404-428. https://doi.org/10.1002/gea.21845

Dokuchaev, V.V., 1967, Russian chernozem, in selected works of V. V. Dokuchaev, vol. I. Moskva, 1948. Translated from the Russian by Israel Program for Scientific Translations, Jerusalem,1, 14–419.

Goudie, A., 1990, The landforms of England and Wales: Oxford, Blackwell Scientific, 398p.

Holliday, V.T., 2009, Geoarchaeology and the search for the first Americans: Catena, 78(3), 310-322. https://doi.org/10.1016/j.catena.2009.02.014

Klinge, M., Schneider, F., Li, Y., Frechen, M., Sauer, D., 2022, Variations in geomorphological dynamics in the northern Khangai Mountains, Mongolia, since the Late Glacial period: Geomorphology, 401, 108113. https://doi-org.2443/10.1016/j.geomorph.2022.108113

Nikiforoff, C.C., 1943, Introduction to paleopedology: American Journal of Science, 241(3), 194–200. https://doi.org/10.2475/ajs.241.3.194

Polynov, B.B., 1927, Contributions of russian scientists to paleopedology: Leningrad, USSR Academy of Sciences, 32 p.

Retallack, G.J., 1998, Core concepts of paleopedology: Quaternary International, 51-52, 203-212. https://doi.org/10.1016/S1040-6182(97)00046-3

Retallack, G.J., 2001, Soils of The Past: An Introduction to Paleopedology, 2nd edition: Oxford, UK, Blackwell, 600 p.

Retallack, G.J., 2009, Refining a pedogenic CO2 paleobarometer for quantifying the middle Miocene greenhouse spike: Palaeogeography Palaeoclimatology, Palaeoecology 281, 57–65. https://doi.org/10.1016/j.palaeo.2009.07.011

Retallack, G.J., 2013, A short history and long future for Paleopedology, in Driese, S.G., Nordt, L.C. (eds.), New frontiers in paleopedology and terrestrial paleoclimatology, Special Publication 104: USA, Society for Sedimentary Geology, 5-16. https//doi.org/10.2110/sepmsp.104.06

Sheldon, N.D., Tabor, N.J., 2009, Quantitative paleoenvironmental and paleoclimatic reconstruction using paleosols: Earth-Science Reviews, 95(1-2), 1-52. https://doi.org/10.1016/j.earscirev.2009.03.004

Targulian, V.O., Goryachkin, S.V., 2004, Soil memory: Types of record, carriers, hierarchy and diversity: Revista Mexicana de Ciencias Geológicas, 21(1), 1-8.

Yaalon, D., 1971, Paleopedology: Origin, nature and dating of paleosols: Jerusalem, Israel University Press, 250p.

Yaalon, D., 1975, Conceptual models in pedogenesis. Can soil forming functions be solved?: Geoderma, 14, 189-205. https://doi.org/10.1016/0016-7061(75)90001-4

Yalçın, M.N., Wilkes, H., Plessen, B., 2021, Organic geochemical characterization of Early-Mid-Holocene swamp deposits near the Neolithic settlement in Yenikapı-Istanbul: Assessment of environmental variability and anthropogenic impacts: Holocene 31(11-12), 1690-1704. https://doi.org/10.1016/j.palaeo.2012.11.016