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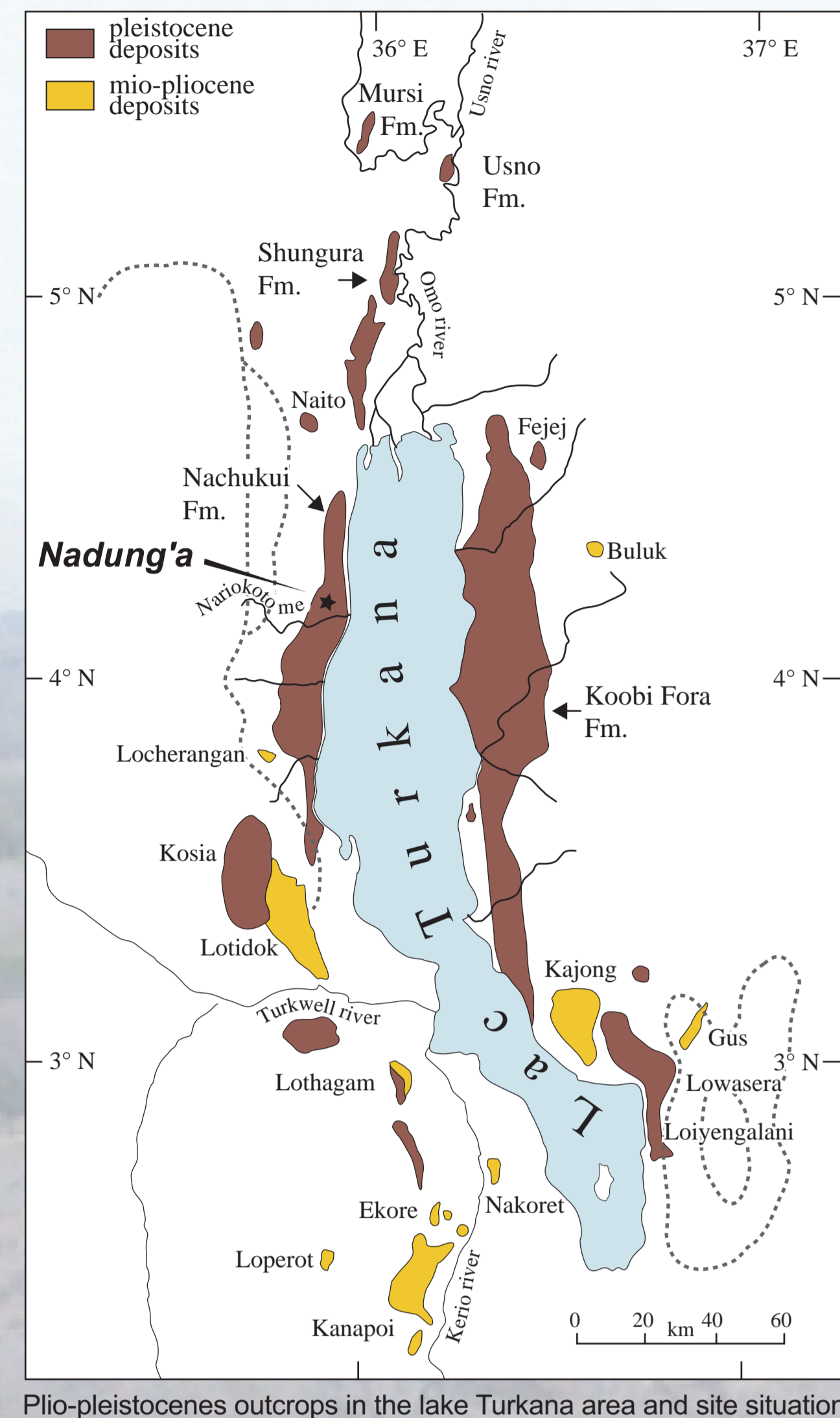


# Argilliturbation and Site Formation Processes in East Africa: the case of Nadung'a 4

East-African Plio-Pleistocene deposits contains archaeological sites from fluvio-lacustre environment. A number of works allow us to discuss the modifications of assemblages recovered from fluvial channel or banks. In contrast, sites retrieved from floodplain deposits are generally assumed to be well preserved and few studies have addressed site formation processes in such environments. The site of Nadung'a 4 has yielded detailed data concerning typical modifications in this environment.

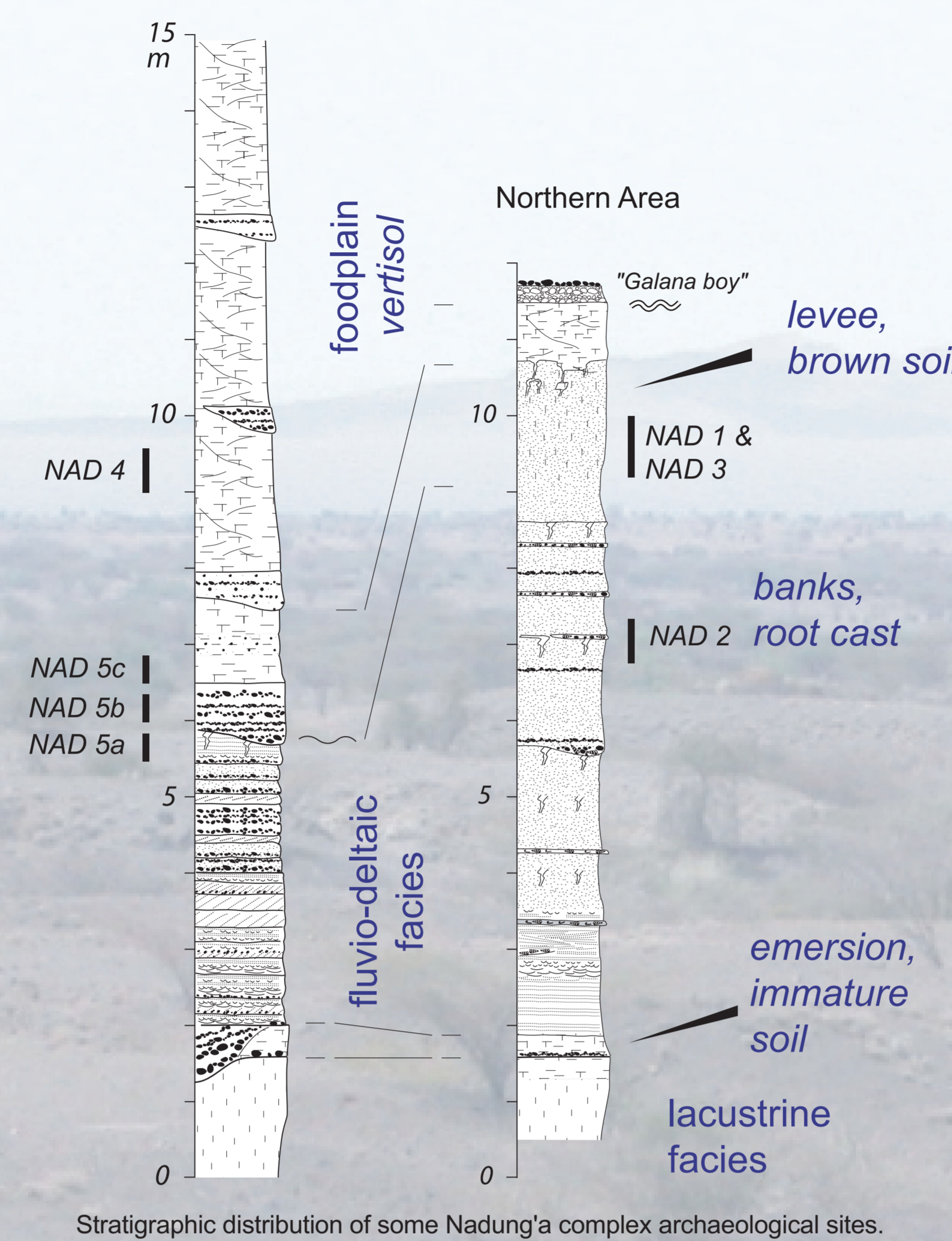
## The site

Nachukui formation deposits are located on the west side of lake Turkana and have a cumulative thickness of 712 m for the period 4-0,7 million years. Paleolithic sites are discovered along modern ephemeral stream eroding these deposits. In the Nadung'a stream area are retrieved the more recent sites of the formation (ca 0,7 Mya). Presently, a dozen sites are known from different lithofacies. A surface measuring 53 m<sup>2</sup> has been excavated at the site 4 of the Nadung'a complex, and an assemblage of 6800 lithic artifacts recovered. The majority of the assemblage consists of flakes and cores produced by a discoid reduction method. Formal tools are represented by notches and denticulates. A few heavy duty tools (e. g. worked pebbles, and hammerstones) complete the assemblage. Faunal remains are equally present and consist in a partial carcass of an elephant.



Plio-pleistocenes outcrops in the lake Turkana area and site situation

## Southern Area

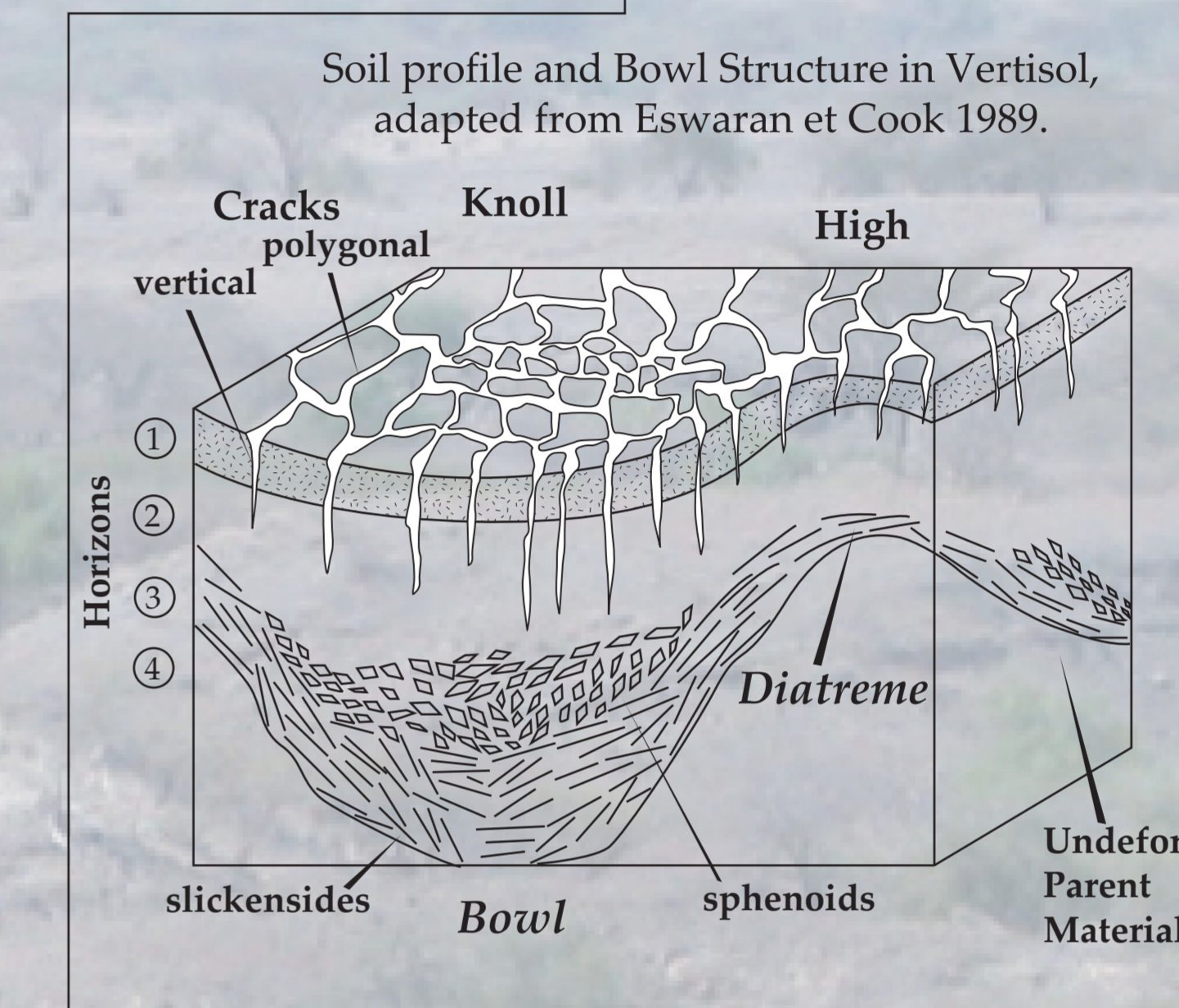
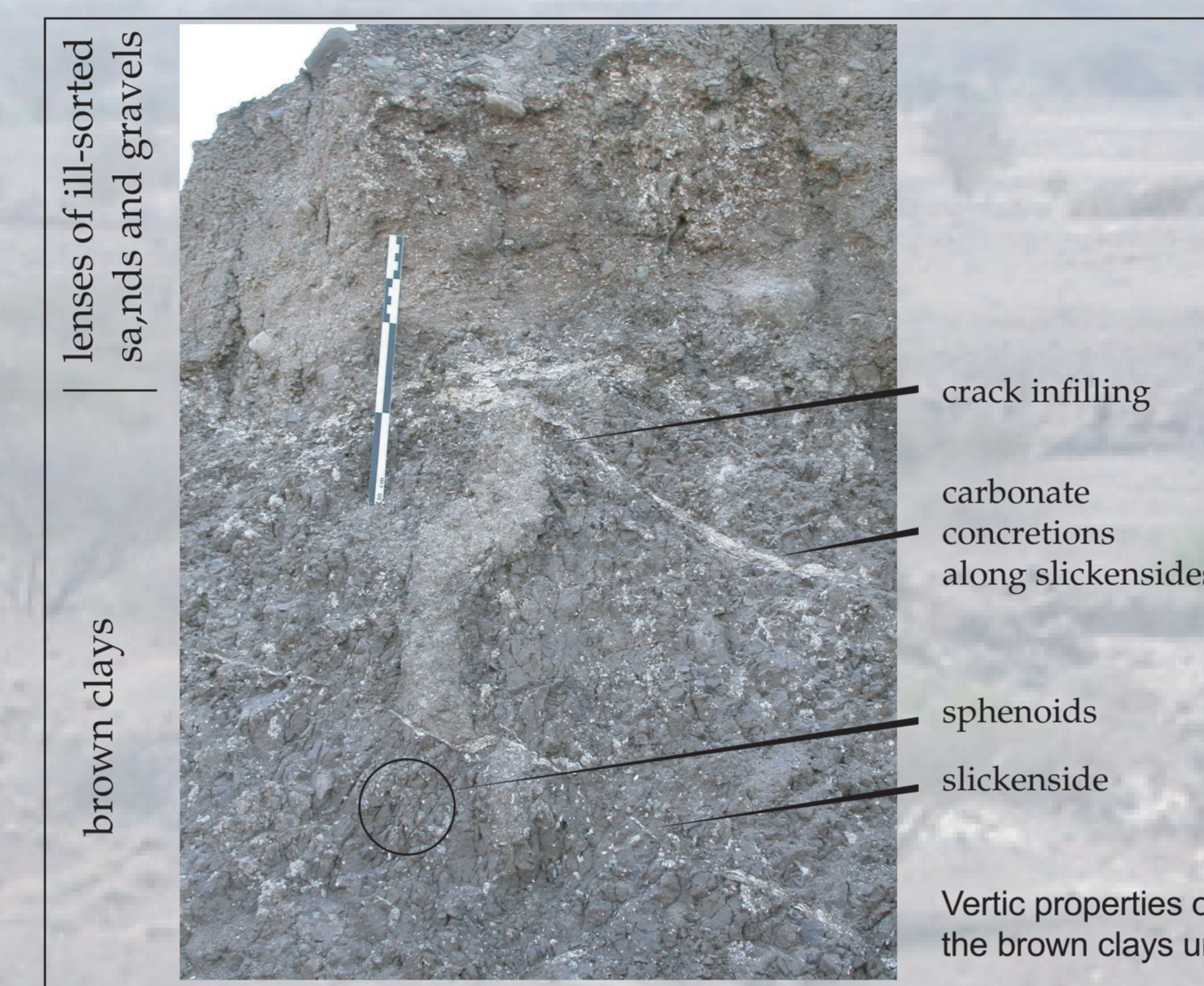


Stratigraphic distribution of some Nadung'a complex archaeological sites.

## Sedimentological data

The one meter thick archaeological level is contained in a unit of brown clays including lenses of ill-sorted sands and gravels. These deposits are interpreted as an ancient mud flat crosscut by small streams and regularly swamped during the seasonal floods of the lake or tributaries. Noteworthy features of the clays are prismatic structure, slickensides and cracks filled with sands indicative of a vertisol type paleosol. In thin sections, crack infilling and cross-striated b-fabric support this interpretation.

The thickness of the deposits and the superposition of features associated with initially distinct horizons indicate a cumulative soil. Present-day examples of this type of soil are encountered in low topographical positions, such as floodplains, in semi-arid regions with an alternation of long dry seasons and short pluvial events, which typically support woody savannah vegetation.



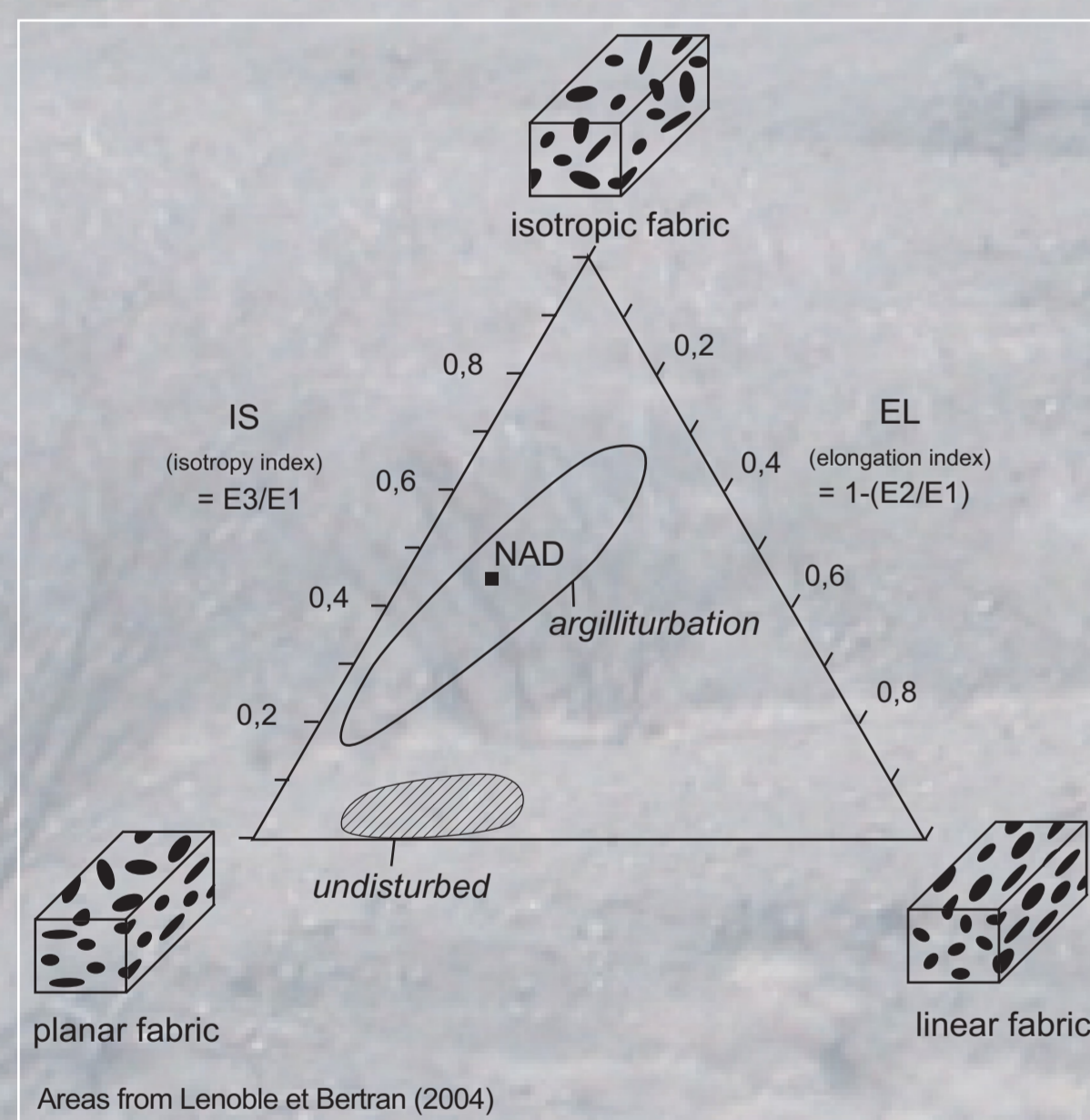
Vertisol pedogenesis is typical of wet/dry tropical climates with soil swelling upon wetting and shrinking when dried. If well expressed, the profile is constituted by a top organic-mineral horizon under which is the horizon characterized by wedge-shaped parallel aggregates (sphenoids) and cracks during dry conditions. Glossy striated surfaces (slickensides) occur in the underlying horizon.

Micro-relief in such soils is known as gilgai, i. e. micro-knolls and micro-depressions more or less regularly arranged with a diameter generally measuring a few meters. To the micro-lows on the landscape correspond a "bowl-shaped" arrangement of the slickensides and the sphenoids.

Under Tropics, floodplain deposits commonly support a vertisol pedogenesis. It is for this reason that argilliturbation is likely to disturb sites in this context. In East Africa, a significant number of archaeological sites are found in deposits with vertic properties: Lokalelei 1, Kokiselei 4, Gona - OGS7, etc.

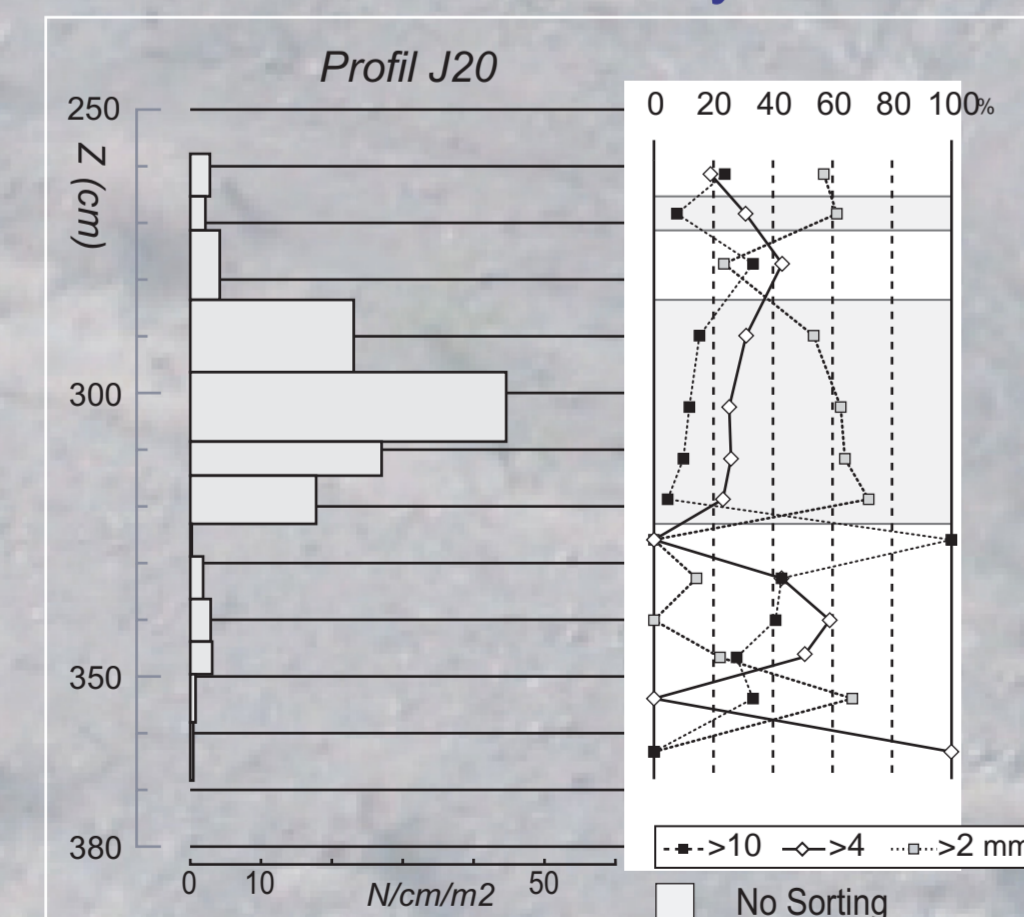
## Archaeological data

Excavations provide several lines of evidences for determining the role of natural site formation processes:



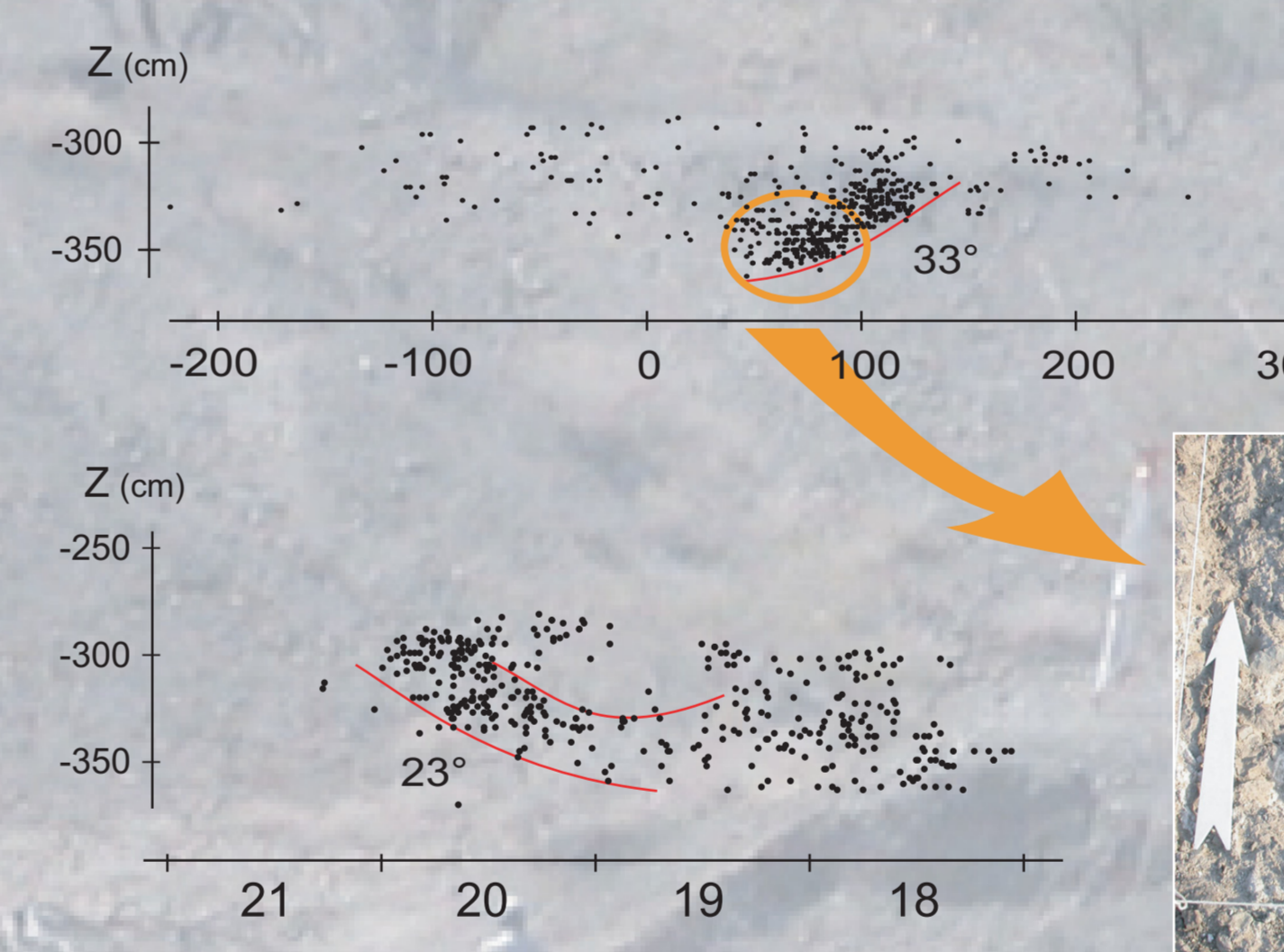
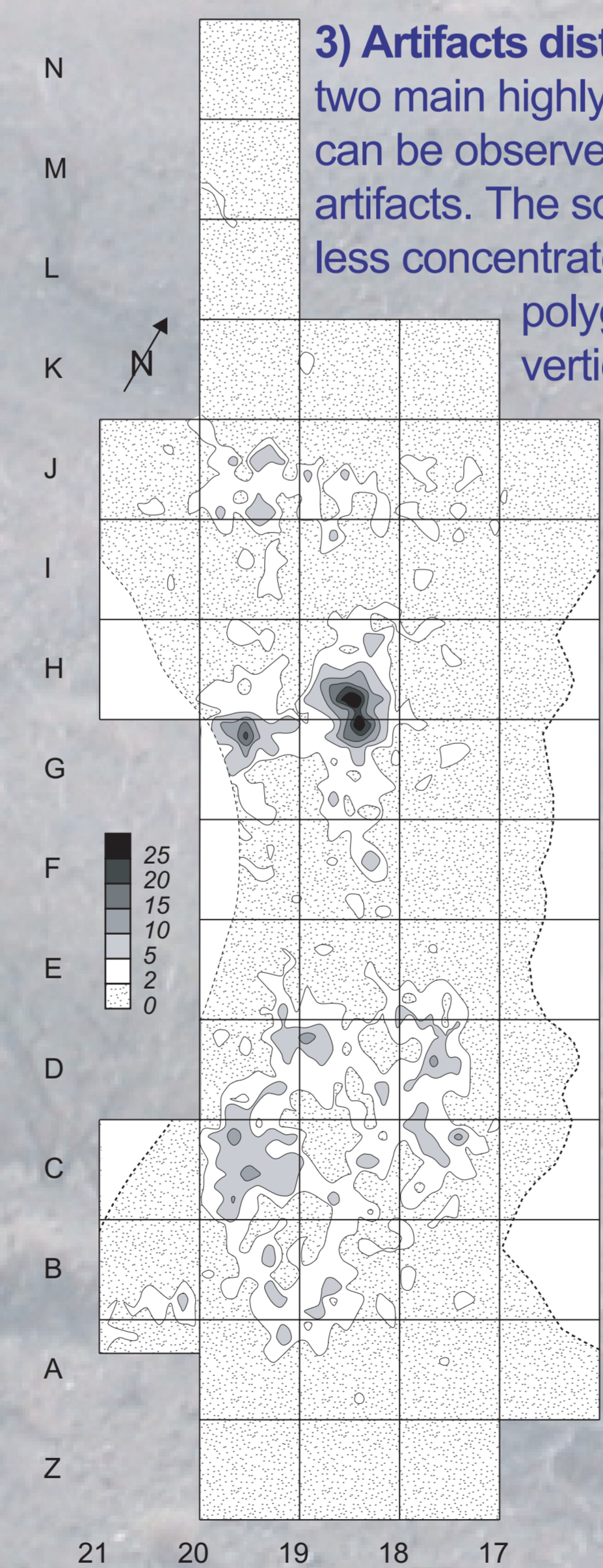
1) Orientation and dip: the orientation and dip measurements of mapped artifacts in Benn's diagram indicate that Nadung'a 4 is typical of archaeological sites disturbed by argilliturbation.

2) Vertical size sorting: vertical displays of artifact density show a gaussian distribution where the greatest part of the assemblage is included in a 0,4 meter-thick layer. This indicates an origin from a single archaeological level. Size artifacts proportions compared to those produced by experiments point out no sorting for this richest layer and sorting for the debris scattered outside this layer.

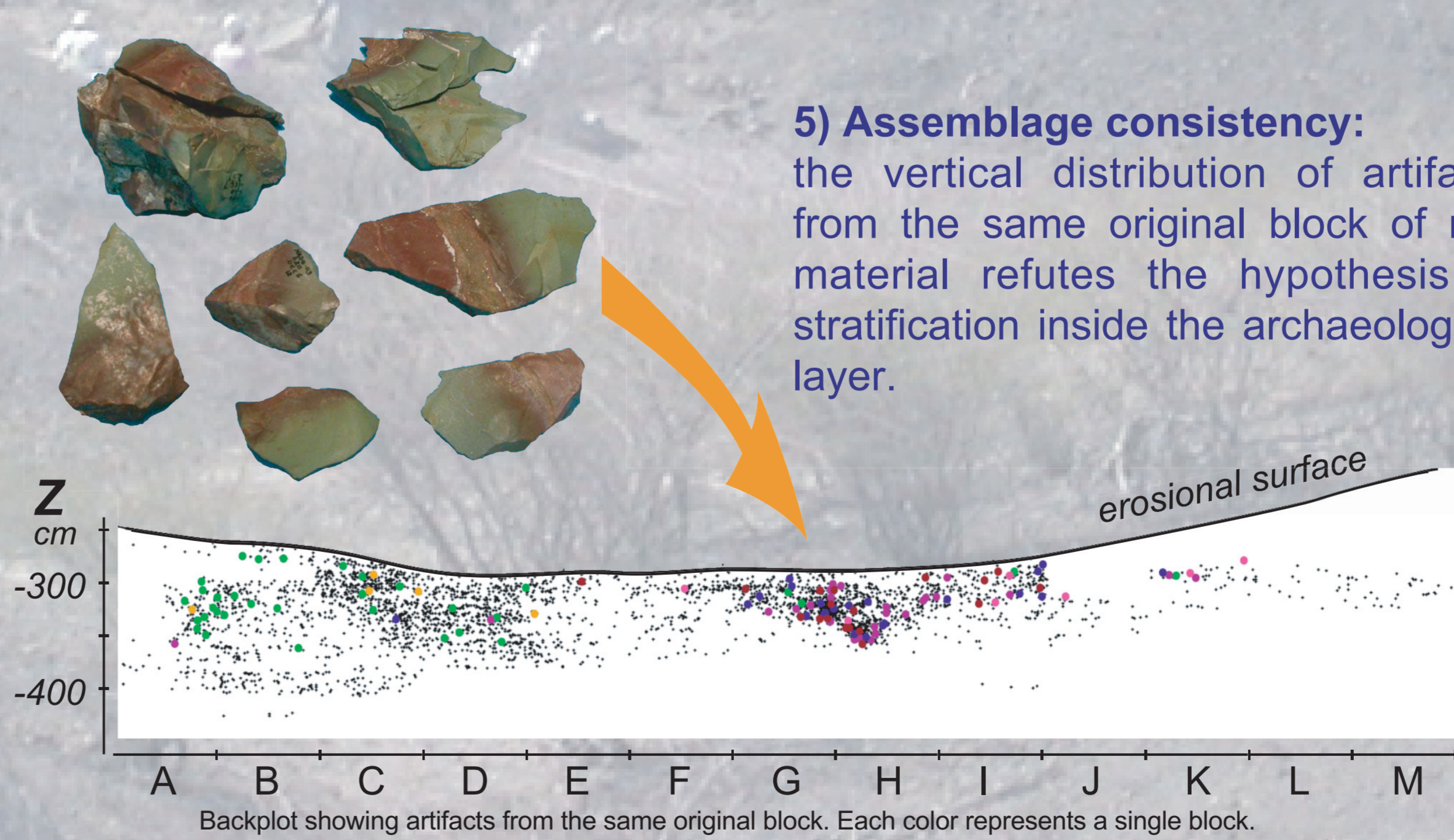


All of these data support the interpretation that a single archaeological level was modified by argilliturbation. Sliding along slickensides was the main cause of this disturbance.

3) Artifacts distribution: two main highly concentrated areas can be observed on the map of artifacts. The southernmost one is less concentrated and presents a polygonal network. On vertical backplots, the archaeological layer is thicker in the southern part of the site. Low density areas in the centers of the polygons appear as depressions with well-defined lower boundaries. These slanted outlines explain the undulating appearance of the archaeological layer. Their shape and distribution are similar to those of the slickensides associated with a bowl structure in the lower horizon of a vertisol.



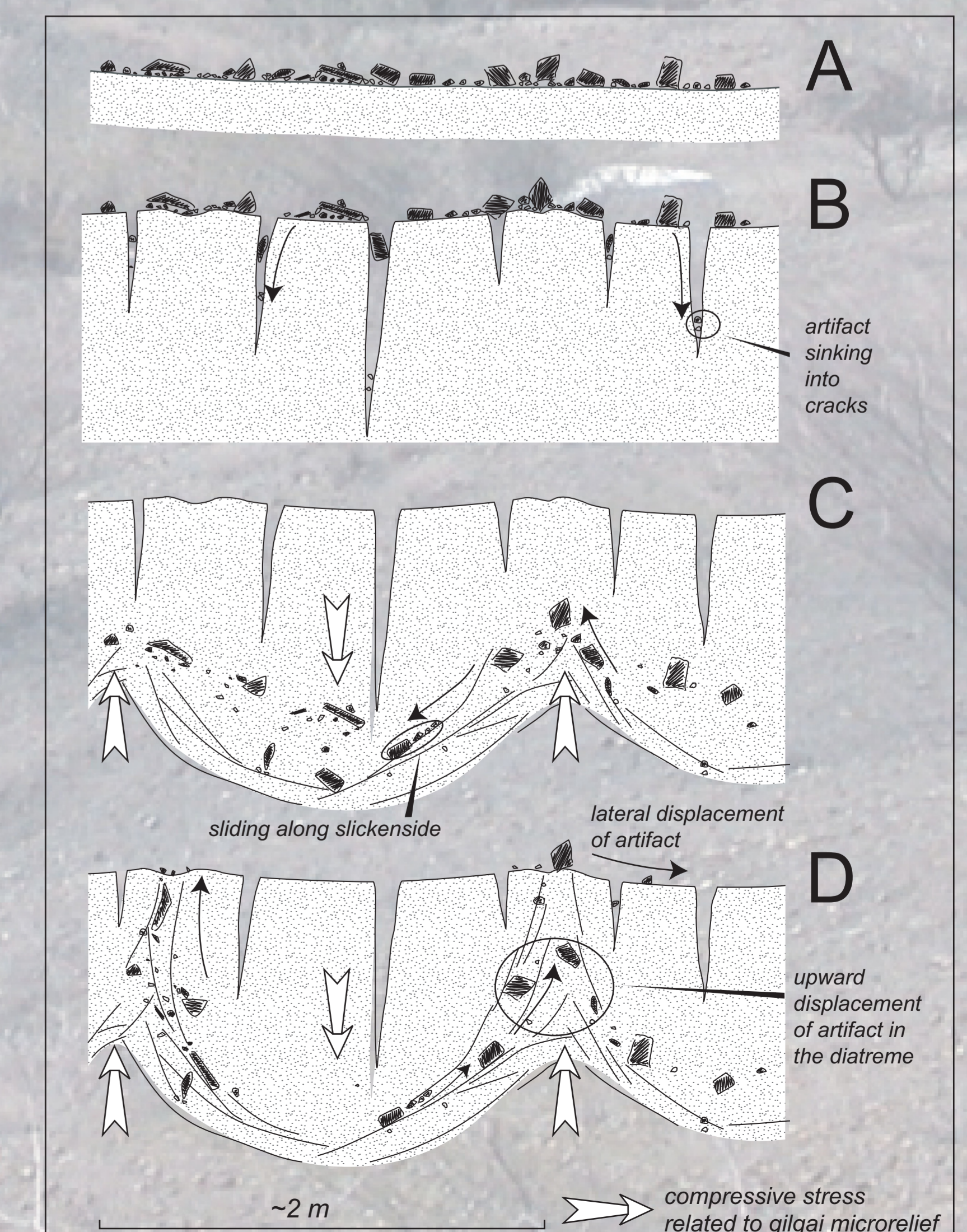
4) Field evidences: the correspondence between sharp lower boundaries of the artifact layer and slickensides has been observed during excavations.



5) Assemblage consistency: the vertical distribution of artifacts from the same original block of raw material refutes the hypothesis of stratification inside the archaeological layer.

## Discussion

Argilliturbation affected artifact distributions are typically interpreted as the result of sinking into desiccation cracks. Distributions at Nadung'a 4 cannot be explained in this way. Thus, we propose a new model of perturbation by argilliturbation. Our model stresses the role of sliding along slickenside and their related bowl shaped structure. This model can explain the upward and downward movement of artifacts, as well as the polygonal pattern of artifact distribution.



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