From rockshelter to landscape: drainage system analyses in the northern Lake Abaya area

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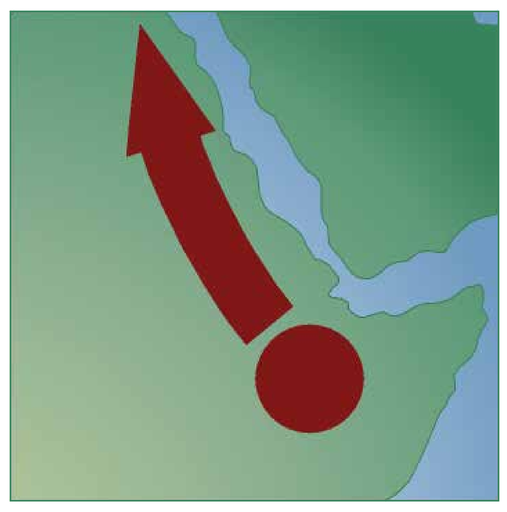

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Our Way to Europe

Culture-Environment Interaction and Human Mobility in the Late Quaternary

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Project A1: Out of Africa - Late Pleistocene Rock Shelter Stratigraphies and Palaeoenvironments in Northeastern Africa

INTRODUCTION Influenced by natural conditions and anthropogenic impacts, periodical runoff and actively eroding river valleys lead to gully erosion within Bisare River catchment (SW Ethiopian Highlands). Widespread degraded areas have exposed obsidian raw material outcrops and archaeological assemblages of all Stone Age periods. Roughly 10 km westwards, Mochena Borago rockshelter is located, which is under study for Late Pleistocene to Holocene occupation of anatomically modern humans and builds the chronological framework for integration of LSA and MSA assemblages. Drainage system and geomorphological analyses are conducted to understand actual and ancient fluvial dynamics and archaeological preservation within the catchment of the Bisare River and Mt. Damota.

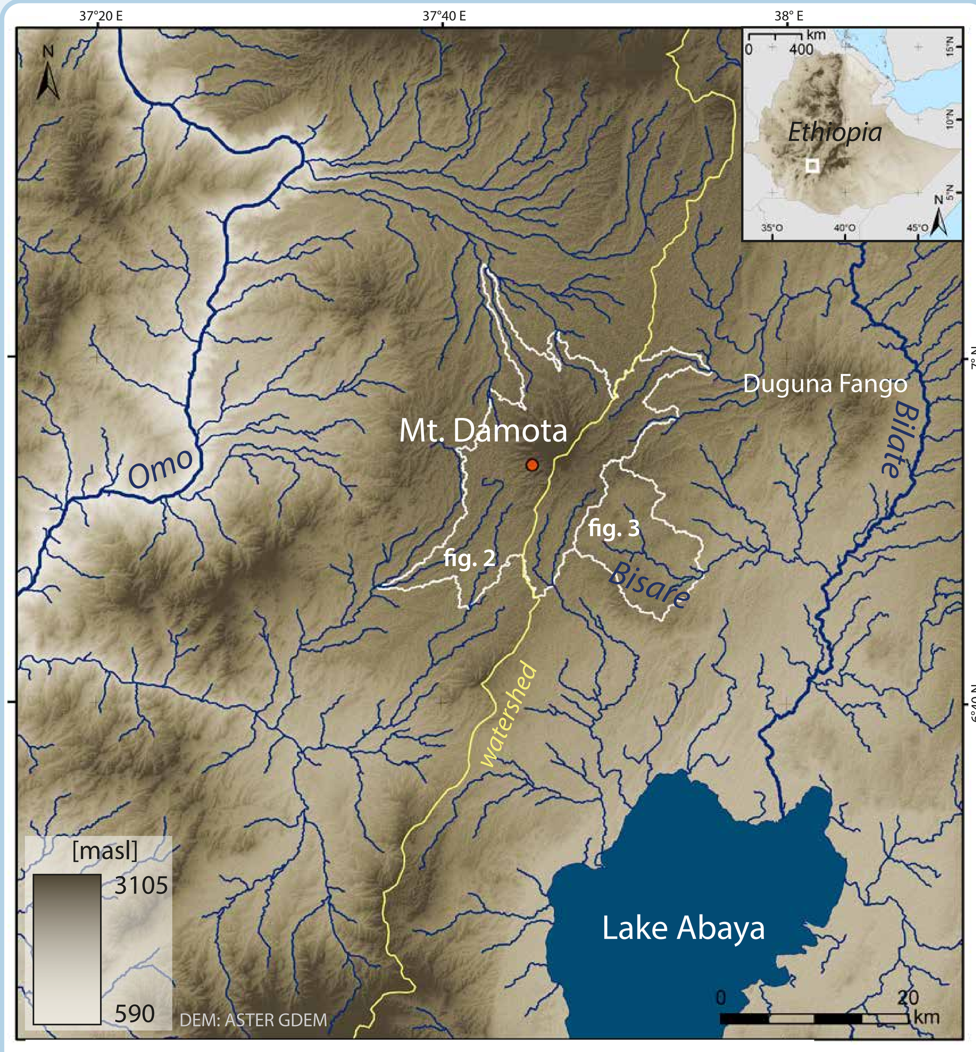

Fig. 1: Study area north of Lake Abaya, Southwest Ethiopian Highlands. Drainage and catchment system is calculated using ASTER GDEM. Watershed (yellow line) of Omo and Bilate Rivers crosses Mt. Damota.

METHODS Degraded areas within Bisare catchment were mapped during survey and using high-resolution satellite imagery (Astrium's Pléiades, 2.0 m resolution). Hydrology analysis of digital elevation models (DEM) in high-resolution (Astrium's Pléiades, 0.5 m) and middle-resolution (ASTER GDEM*, 30.0 m) were conducted by ArcGIS HydroTools to map surface runoff, catchments, and watersheds in the northern Lake Abaya area, Mt. Damota, and Bisare River area. Longitudinal profiles are extracted for Mochena Borago drainage runoff and Bisare River to determine river morphology. Artifact occurrences and obsidian raw material exposures were mapped during survey.

Mount Damota catchment

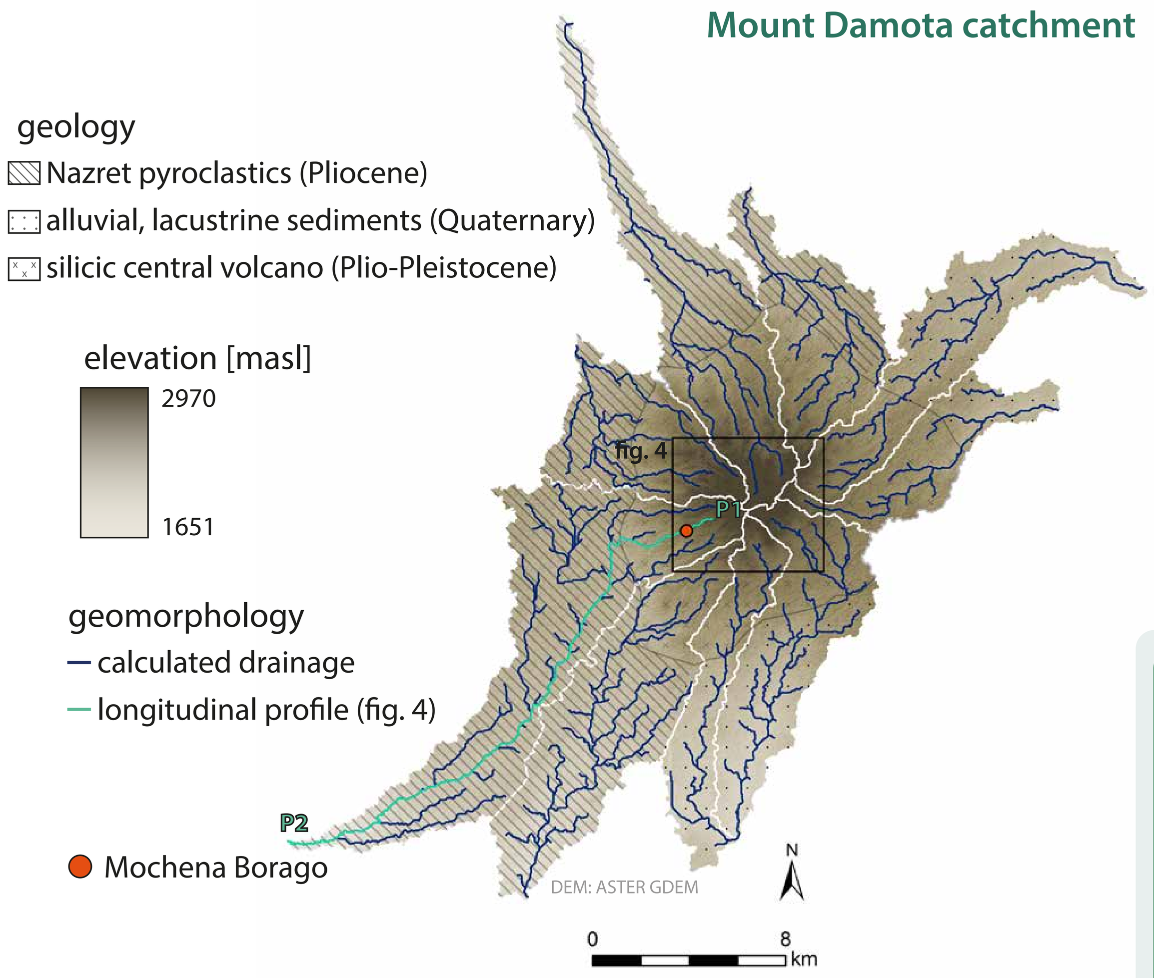

Fig. 2: Calculated catchments (white) and drainage lines (blue) of Mt. Damota using ASTER GDEM. Geology is added from Chernet (2011) and Corti et al. (2013). Mochena Borago drainage runs off into Omo River (fig. 1). Longitudinal profile is given in fig. 4.

RESULTS & DISCUSSION Mt. Damota runoff drains both into Omo River (west) and Lake Abaya (east) systems (fig. 1). Outflow at Mochena Borago rockshelter drains into Omo River (fig. 4), whereas Bisare River (fig. 3) runs off into Bilate River that is the main contributary of Lake Abaya (fig. 1). Bisare River catchment is marked by large degraded areas (fig. 3) that expose archaeological assemblages (fig. 5) and obsidian raw material (fig. 6). River longitudinal profiles both start convex and turn concave (fig. 4 C, 5 F) and partly show knickpoint occurences. Preliminary ^{14}C dating revealed modern ages of the swamp at 3 m depth below surface, drilled 10 m east of BIS05 (fig. 5), which refers to high sedimentation rates in this area.

Bisare River catchment

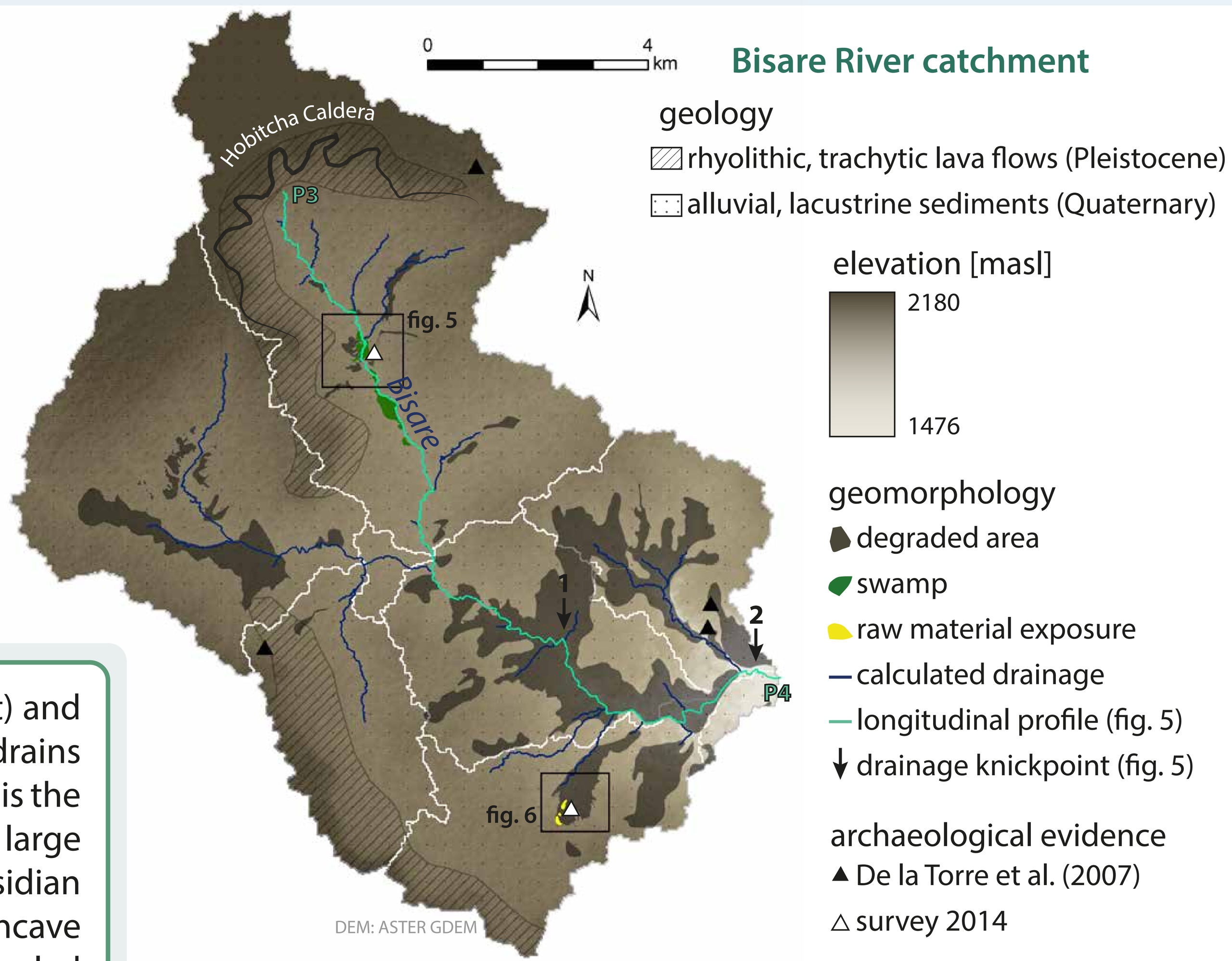

Fig. 3: Bisare River calculated catchment, sub-catchments (white, ASTER GDEM) and drainage lines (blue, Pléiades DEM). Bisare longitudinal profile (P3-P4) is given in fig. 5. Geology is added from Chernet (2011) and Corti et al. (2013). Degraded and swamp areas are mapped using Pléiades satellite imagery. Raw material exposure and archaeological material were mapped during survey 2014. Observations from De la Torre et al. (2007) are added.

Mochena Borago catchment

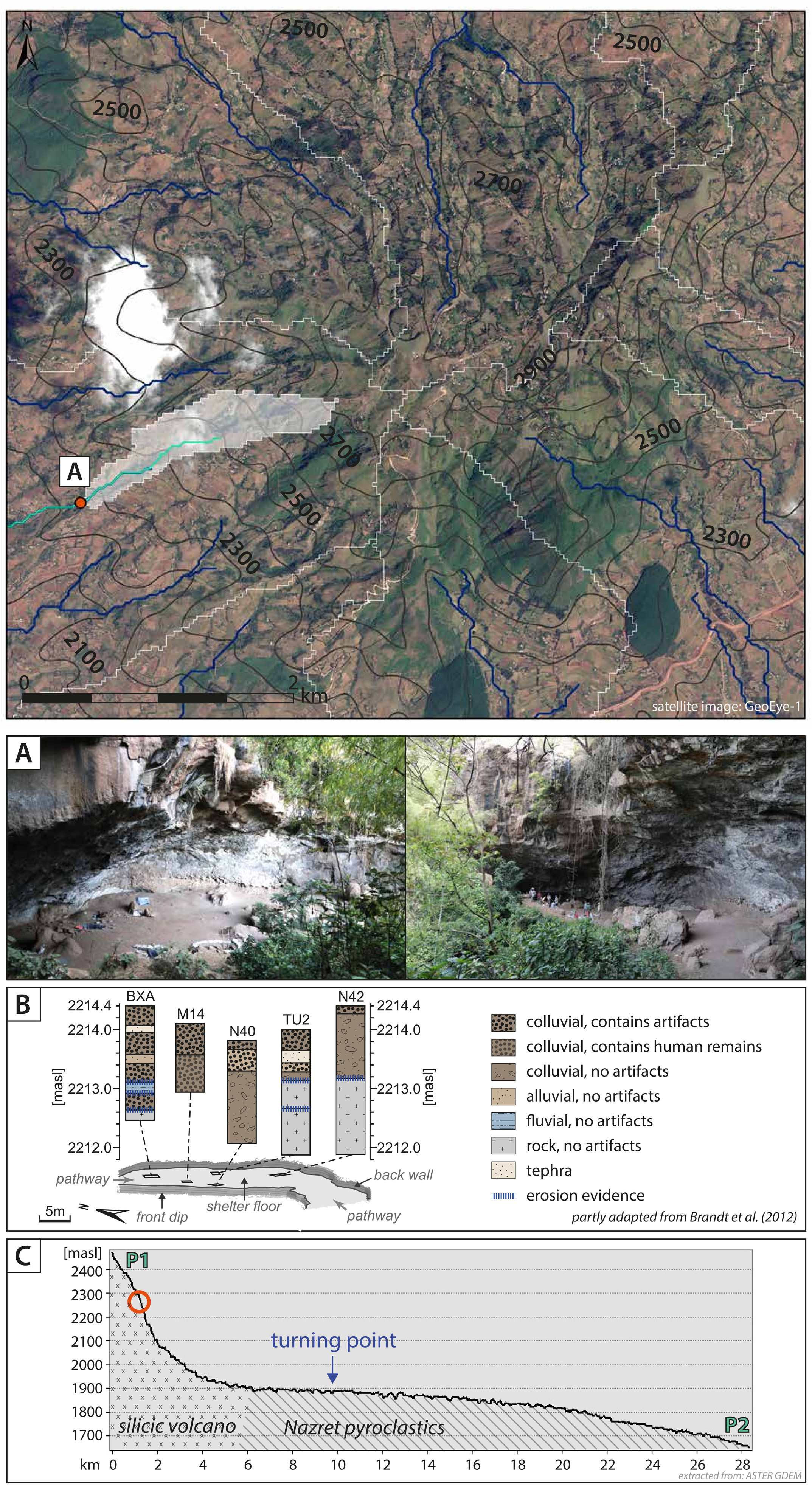

Fig. 4: GeoEye satellite imagery showing Mt. Damota with location of Mochena Borago (red circle) and its calculated catchment using ASTER GDEM. Photographs show the rockshelter from the northern (A left) and southern (A right) entries during field work on excavation areas BXA, M14, N40, TU2 and N42 (B). Longitudinal profile for Mochena Borago runoff (C) starts concave and turns convex, which may be induced by change in rock type from silicic volcano to Nazret pyroclastics (fig. 2).

Bisare River swamp

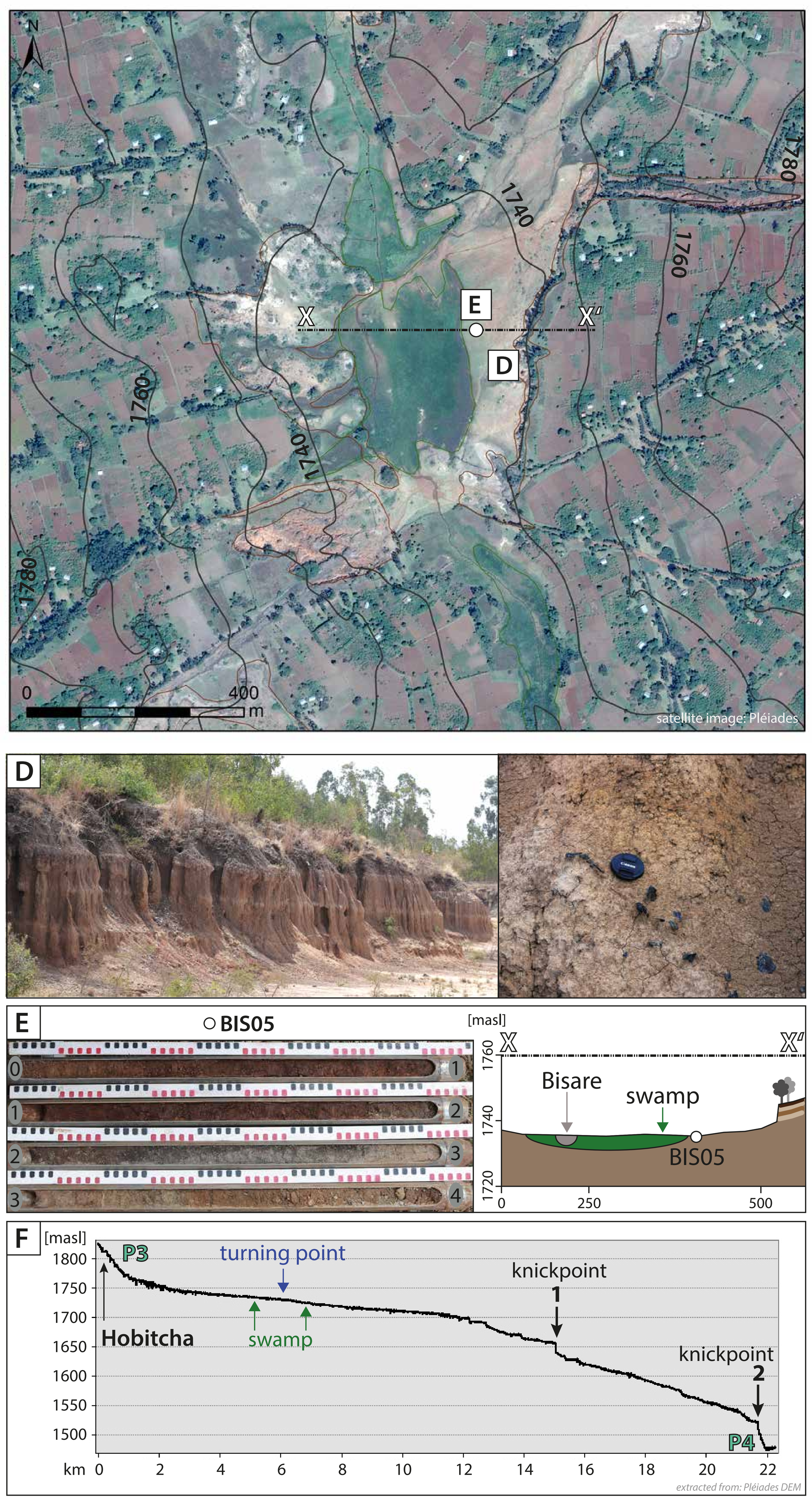

Fig. 5: Pléiades satellite imagery showing area with swamp (green line) and gully erosion (red line) within Hobitcha caldera. Photographs show badlands at 1740 masl boundary (D left) with exposure of artifacts within the sediments (D right). Drilling core BIS05 (E) shows deposits containing reddish-brown slope debris and grayish ashy earth material for the upper 4 m below surface. Longitudinal profile for Bisare River (F) starts concave at the Hobitcha escarpment and turns convex downwards, where swamp areas occur (comp. fig. 3). Knickpoint 1 is assumed to display progressive gully erosion, whereas knickpoint 2 is fault-related according to Corti et al. (2013).

Obsidian raw material exposure

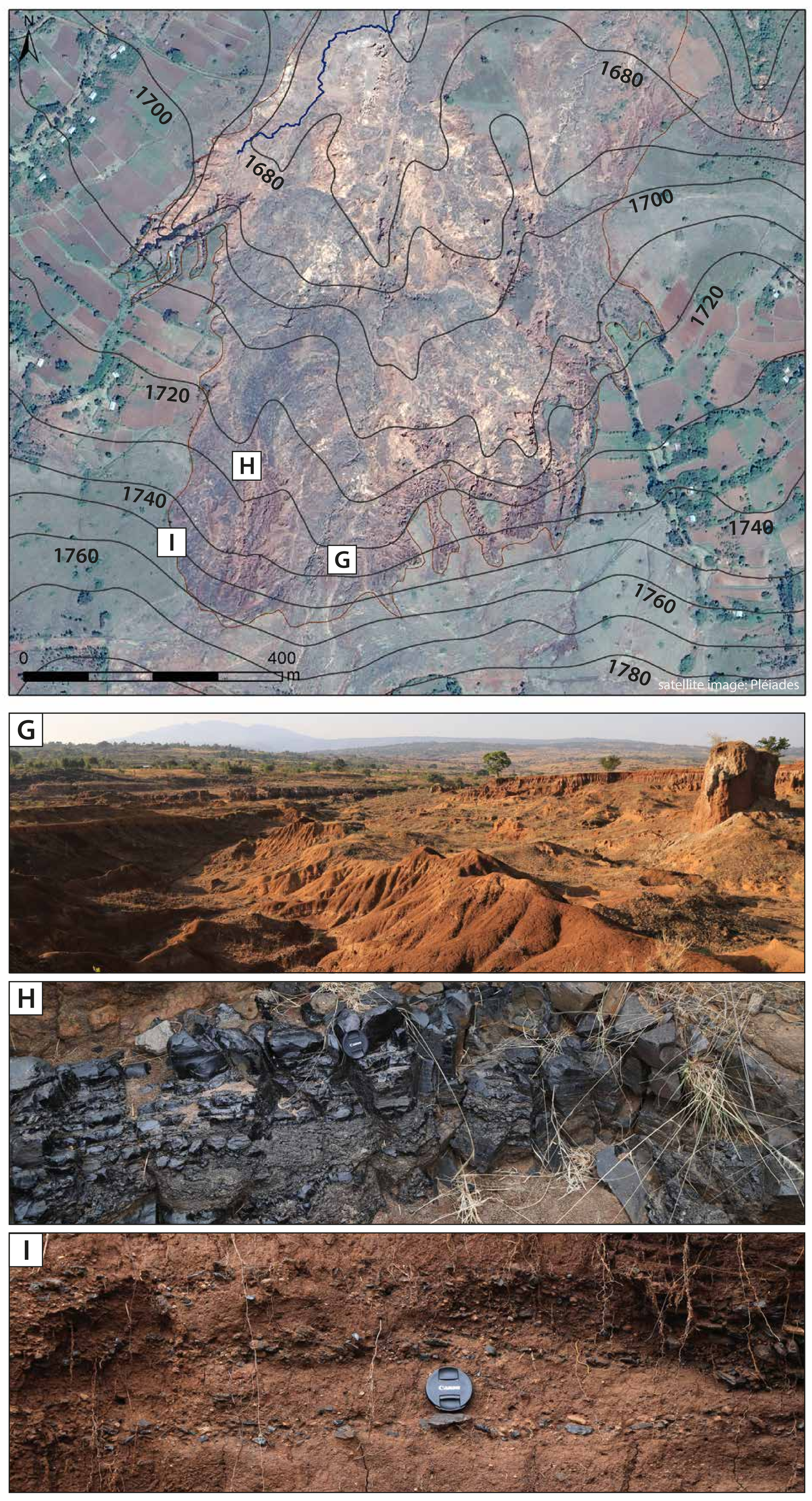

Fig. 6: Pléiades satellite imagery showing obsidian raw material exposure due to gully erosion within the northwestern part of Bisare River catchment (fig. 3). Photographs show area of degradation (G) with north view and obsidian rocks (H) exposed within this area. At the margin of badland occurence, sediments containing archaeological raw material and artifacts are evident (I).

OUTLOOK Both Mt. Damota and Bisare River catchments serve as eroding and accumulating systems. Exposure of obsidian raw material and findings of further archaeological assemblages give more insight into natural-human interactions during the Late Quaternary. Sediments containing archaeological assemblages are affected by degradation that will lead to exposure of important preserved material in the future, which demands investigations of these yet preserved archaeological open-air sites. Further drilling cores will be analyzed for paleoenvironmental and hydrological analyses to understand actual and ancient fluvial dynamics within Bisare River catchment.

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