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RESEARCH ARTICLE

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The Bronze Age occupation of the Black Sea coast of Georgia—New insights from settlement mounds of the Colchian plain

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Abstract

Along the lower course of the Rioni and several minor rivers, more than 70 settlement mounds (local name: *Dikhagudzuba*) have been identified by field surveys and remote sensing techniques. They give evidence of a formerly densely populated landscape in the coastal lowlands on the Colchian plain (western Georgia) and have been dated to the Bronze Age. As yet, limited information is available on their internal architecture, the chronology of the different layers and their palaeoenvironmental context. Based on archaeological sources, remote sensing measurements of three mounds and sediment cores from one mound and its closer surroundings, our study presents a review of the relevant literature and reveals the internal structure, distribution and spatial extent of the mounds. Geochemical and sedimentological analyses of element contents (X-ray fluorescence) and granulometry helped to identify different stratigraphical layers and differentiate between natural facies and anthropogenic deposits; using the Structure-from-Motion technique the mounds' dimensions were calculated. The studied settlement mounds had relatively small dimension (varying from 30 to 100 m in diameter) and were similar in their stratigraphy. Measurement of elements that can identify types of human activity, notably metals and phosphorus, suggest changing intensities of human occupation, pastoral agriculture and metalworking through the occupation sequence. According to the ^{14}C chronology, the formation of the settlements occurred during the first half of the second millennium B.C., which confirms the archaeological interpretation of their Bronze Age origin. The narrow age difference between the lowermost and uppermost anthropogenic layers indicates an intentional construction of the mounds, rather than a successive accumulation of construction debris due to the disintegration of loam bricks by weathering. Therefore, they are indeed *mounds* and not *tells*. It is most likely that the characteristic circular moats that surround them were the source of their construction material. Fluvial and alluvial processes in a warm and humid climate dominated the environment of the mounds.

KEYWORDS
Bronze age, Colchian plain, Georgia, occupation, settlement mound

1 | INTRODUCTION

Settlement hills are artificially accumulated dwellings, which consist of fine-grained sediments that represent (pre-) historic settlements. They were founded from the Neolithic to the Bronze age and spread from the Fertile Crescent all over the Near and Middle East and SE-Europe (Rosenstock, 2010; Steadman, 2000; Stephens et al., 2019). Although they differ regionally in size, age and occupation period, they can be distinguished concerning their mode of construction. They vary from passively gradual accumulation of occupation debris, dumped ashes, remade floors, occupation deposits etc. due to a millennia-long and consistent occupation (Menze et al., 2006), to intentional accumulation to improve housing conditions, for example, in coastal environs (Ervynck et al., 2012), farming or for defensive or cultural purposes (Fontana et al., 2023).

During the Soviet Era, several archaeological studies were carried out about the settlement mounds of western Georgia (Figure 1). However, since this research was published in Georgian or Russian, it has received only very limited attention internationally. According to these publications, the first settlement mounds in western Georgia appear at the end of the third millennium B.C. in the course of the formation of the alluvial coastal plain that is dominated by the Rioni River and its affluents. There, the settlement mounds are called *Dikhagudzuba*, which can be translated as 'protuberant land' (Kilanava, 2009). Based on current data most of the settlement mounds of the Kolkheti Lowlands can be found in its north-western part between the two major rivers Enguri and Khobistskali, along the courses of minor rivers (Figure 1) and in its southern part along the Rioni (Jibladze & Papuashvili, 2013). In general, it is characteristic for *Dikhagudzubas* to be located in the vicinity of former or still existing river beds, sometimes in groups, creating a single communication axis roughly along the river courses, with a total area of 10–25 ha. Their elevation varies from 1 to 10 m and their diameter between 20 and 200 m. Quite often a central larger mound can be distinguished,

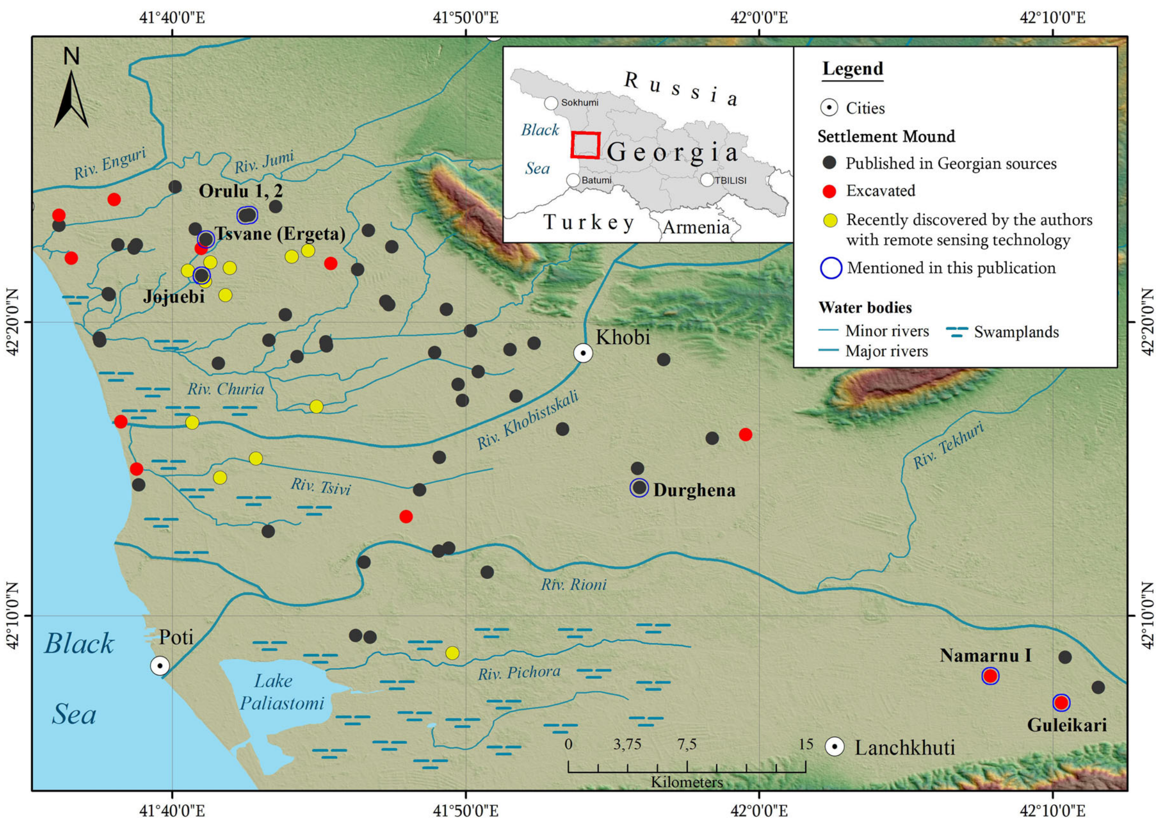

FIGURE 1 Distribution of settlement mounds (*Dikhagudzuba*) on the Colchian plain. The map is based on Aster digital shaded model from Aster global digital elevation model 30 m (NASA) and was processed in ESRI ArcGIS 10.2.2.

surrounded by smaller ones. Usually, these human-made mounds are circled by one or two (seldom three) channels or moats, which are assumed to have a drainage and protective function (Jibladze & Papuashvili, 2013; Kilanava, 2009).

These conclusions correlate well with the geoarchaeological research on three settlement mounds that were recently studied by scientists from the Ilia State University (Tbilisi, Georgia) and the University of Cologne (Germany) (Laermanns, Kirkitadze, et al., 2018). The results indicate that the mounds of the Colchian plain were intentionally accumulated rather than passively evolved. This is seen as a response to the swampy surroundings of the coastal alluvial plain, a phenomenon known in many coastal or alluvial areas across Europe (Ervynck et al., 2012; Meier, 2008; Prummel & Küchelmann, 2022). Although an estimation of the mounds' occupation history remains challenging, their initial construction could be dated to the first half of the second millennium B.C. in the Early Bronze Age (Laermanns, Kirkitadze, et al., 2018).

For the first time, this study offers a comprehensive summary of the Georgian literature on the Colchian *Dikhagudzuba* mounds. It supplies additional information about the mounds' internal structure, spatial extent and distribution to the first research results of Laermanns, Kirkitadze, et al. (2018). By using vibracores taken on the top, the slope, and in the direct vicinity of one of the studied mounds and granulometrical and geochemical analyses, different stratigraphic layers were determined. Construction layers and natural deposits could also be identified. To validate the first drone-based Structure-from-Motion (SfM) photogrammetry model for three further settlement mounds, their dimensions and structures were computed and estimated. After a careful analysis of the collected material (Jibladze & Papuashvili, 2013; Kilanava, 2009; Laermanns, Kirkitadze, et al., 2018; Mikeladze, 1978), the data of known and excavated settlement mounds were incorporated into the GIS database and completed with aerial reconnaissance to create a map of the *Dikhagudzubas*' distribution in the Kolkheti lowlands.

2 | REGIONAL SETTING

2.1 | Geomorphological setting

The ancient region of Colchis corresponds to the Kolkheti lowlands, also known as the Colchian plain, which forms a triangular-shaped coastal alluvial plain on the west of Georgia and is dominated by the Rioni river (Figure 1). The plain is bordered by the Black Sea to the west, the slopes of the Greater Caucasus in the northeast and the Lesser Caucasus in the southeast. The easternmost border is formed by the lower Likhi range that connects both Caucasian ranges. This divides the westbound catchment of the Rioni from the catchment of the Kura, which discharges eastwards into the Caspian Sea (Eppelbaum & Khesin, 2012).

The Colchian plain is, like the whole of Georgia, located in the convergence zone between the Arabian and Eurasian plates (Dhont & Chorowicz, 2006). The ongoing northward drift of the former plate causes an enduring continent-continent collision between the Lesser Caucasus arc and the Eurasian basement, with convergence rates of ~2 mm/a in that area (Avdeev & Niemi, 2011; Yılmaz et al., 2013). In contrast to the older Caucasus ridges, the Colchian plain is primarily covered by Cretaceous and Palaeogene sediments and by volcanoclastics (Bazhenov & Burtman, 2002). The present geomorphology of the Colchian plain is formed by Pleistocene molasses and river terraces, overlain by Holocene fluvial and alluvial deposits (Adamia et al., 2011).

During the Holocene, the region was also severely influenced by the significant sea-level rise, which was caused by the reconnection of the Black Sea with the Mediterranean Sea ~7400–6400 B.C. (Giosan et al., 2009; Ryan, 2007) and until ~3000 B.C., when this rise decelerated considerably. (For detailed information on the Holocene sea-level rise and its consequences for the coastal evolution of the Black Sea see, e.g., Brückner et al., 2010; Fouache et al., 2012; Kelterbaum et al., 2012; Laermanns, Kelterbaum, et al., 2018; Laermanns et al., 2019).

Today, the central Colchian plain is dominated by the Rioni river. Its catchment area of ca. 13,400 km^2 covers a great part of western Georgia, and its water volume contribution to the Black Sea of 13.38 km^3/a and sediment load of 6.02×10^6 t/a are higher than the adjacent Georgian rivers totaled together (Berkun et al., 2015). Besides the Rioni, the rivers Enguri and Khobistskali further to the north are of notable importance for the central section of the Colchian plain. All three originate from the Greater Caucasus and their Holocene deposits formed the alluvial coastal plain (Adamia et al., 2011).

As a result of this alluvial accumulation and the sea-level evolution, the recent landscape of the Cochian plain is dominated by vast lowlands consisting of alluvial plains covered by forests of evergreen understory trees, open meadows and fields for crop growth. The extensive swamp and reed areas, ponds and smaller lakes (Box et al., 2000) have been limited since the 20th century when drainage was introduced to the region (de Klerk et al., 2009; Nikolaishvili et al., 2011). The vegetation benefits from annually warm average temperatures and a humid climate with high precipitation (>2000 mm/a) (Box et al., 2000; Hijmans et al., 2005). Based on pollen records taken from southern parts of the Colchian plain, species-rich open wetland forests (e.g., *Zelkova* and *Castanea* forests) are indicated for the time of the mounds' foundation in the early second millennium B.C. (Connor et al., 2007; de Klerk et al., 2009; Kvavadze & Connor, 2005; Shatilova et al., 2010). This is especially the case for the climate optimum between 1850 and 400 B.C., pollen data implies a predominance of warm and humid conditions, covering the heyday of the Colchian culture as well as the time of the Greek colonisation (cf. Connor & Kvavadze, 2008; de Klerk et al., 2009).

2.2 | Historical background

The Colchian culture developed continuously without any known sudden hiatus from the first Neolithic occupation of that region (Fähnrich, 2010). Archaeological findings clearly show that the Kolkheti lowlands have been quite densely settled since the Early

Bronze Age. The oldest known settlements in the Kolkheti lowlands are Ispani (Connor et al., 2007; de Klerk et al., 2009; Papuashvili & Papuashvili, 2014), located north of the town of Kobuleti, and Ontskoshia (Janelidze & Tatashidze, 2010), close to the town of Anaklia in the vicinity of the river mouth of the Enguri. They were radiocarbon-dated to the late fourth to mid-third millennium B.C., that is, the transition between the Chalcolithic and the Early Bronze Age in this region (Lordkipanidze, 1991). However, the older age is still disputed and lacks general recognition (Kavtaradze, 1983). The absence of archaeological findings from earlier periods might be explained by the fact that the Kolkheti lowlands have been (and still are) subjected to heavy fluvial and alluvial sedimentation and tectonic depression, with accumulated sediment thickness reaching up to 30–40 m in its western part (Adamia et al., 2011). Obviously, in such conditions, it is hard to detect traces of possible Neolithic or Chalcolithic settlements.

Reliable reports of the life of the Colchians, their culture and the Kingdom of Colchis are given by Greek and Roman authors since the seventh century B.C., the beginning of the Greek colonisation era, when Milesian Greeks founded several colonies along the eastern Black Sea coast. From the three main cities Dioscurias, Gyenos and Phasis, the latter became the most important due to its location at the delta of the eponymous river (the present Rioni) that connected the Black Sea with the hinterland and heartland of Colchis. Although the city of Phasis is mentioned until Byzantine times, its location remains unrevealed until today.

In contrast to the mythological character of the 'Argonautica' in all of its variations, the writers such as Strabo, Pliny the Elder, Pseudyo-Scymnos, Pseudo-Scylax of Caryanda, Pomponius Mela, Procopius, Agathias and many others focus on the factual description of Colchis (Jouanna, 1996). Besides the high art of metallurgy, they depict the cities, their history, people of different tribes, the landscape and the travelling distances. They highlight the predominant role of the river and city of Phasis. For example, Hippocrates (fourth century B.C.) mentions in his book *On Airs, Waters and Places* that the local population of Colchis 'sail up and down [on river Phasis] with boats carved from whole loges of tree, because there are many channels here'. Moreover, he provides information about the local environment for that time: 'This country is swampy, warm, full of water and forest. Every time of year there are frequent rains. People live in swamps, they have houses of wood and reeds on the water…' (cf. Jouanna, 1996). In 'Geographica', Strabo also mentions that people were sailing on boats along the river and many connecting channels deeming the rivers as main transportation routes (cf. Gamkrelidze, 1992). Furthermore, Strabo describes the transit route from the Black Sea to the Caspian Sea (Strabo, XI, II, 3 and 17).

After its heyday between the sixth and fourth centuries B.C., the Kingdom of Colchis fell into the sphere of influence of the Kingdom of Pontus and was incorporated in the late second to early first century B.C. into Pontus. During the third Mithridatic War (73–63 B.C.), the territory was devastated by Gnaeus Pompeius Magnus and became a client state of the Roman Empire after Mithridates' defeat in 63 B.C. (Braund, 1994; Gamkrelidze, 2012).

2.3 | Archaeological background

Altogether, more than 70 *Dikhagudzuba* mounds were identified on the Colchian plain (Figure 1). The majority of the mounds are located between the rivers Enguri and Rioni, and 40–50 km inland from the recent shoreline. They are all located in close vicinity to (assumed) palaeochannels of different sizes. Apart from that, more settlement mounds might be found north of the Enguri, in the northern Colchian plain. However, the political situation in the separatist Republic of Abkhazia forbids further research there.

In general, the *Dikhagudzuba* mounds are assigned to the Bronze Age Colchian culture that prevailed in the western part of Georgia until the Pontic and Roman conquests in the late first millennium B.C. (Fähnrich, 2010; Lordkipanidze, 1991). They are described by several Greek authors, such as Hippocrates in his treaty *On Airs, Waters and Places* (fifth century, §15; cf. Jouanna, 1996), by Xenophon in the *Anabasis* (*Anabasis* 5.4.31-34) and also by Diodorus Siculus (14.30.6-7) (cf. Dan, 2014, 2016).

One of the earliest archaeological studies addressing settlement mounds on the Colchian lowlands is attributed to N. Khoshtaria, who published his work in 1944, clearly indicating the artificial characteristics of these dwelling forms, and proposing the hypothesis about distinct environmental conditions during the time of their construction. The same hypothesis was followed by Kuftin, who published a significant study entitled 'Materials of Colchis archaeology' in 1950.

Several authors observed a certain pattern in the distribution of settlement hills, being located along the rivers (or former river bed) in several groups, especially in the area between the rivers Enguri and Khobistskali where a great number of smaller rivers drain the area. The authors highlight the linear distribution, with a major central mound in certain cases surrounded by the smaller ones. Each settlement mound seems to be surrounded by one or two, occasionally three moats or wide ditches and is usually connected to an adjacent river or smaller channel. The purpose of such a structure is explained as defensive, water drainage, fishing and/or for shipping and transport (Jibladze, 2001; Khoshtaria, 1944; Kuftin, 1950).

The first attempts to classify the *Dikhagudzuba* mounds were made early in 1944, based on the geomorphology of location and depths of cultural layers below the present sea level (Grdzelishvili, 1945). The analysis of the stratigraphy of excavated mounds and archaeological surveys conducted in the following decades led to several approaches varying from author to author that were summarised in the first systematic review by Jibladze in 2013 who defined three different types of *Dikhagudzuba* mounds:

Type 1: Settlement mounds that consist of a succession of cultural layers. Such hills had been settled for a long period of time, possibly with some periods of abandonment, which then explains the alteration of observed cultural and sterile layers. Major subclasses can be defined: At first, mounds were initially sterile layers that accumulated due to the construction of the artificial embankment and cultural layers on top. Such monuments are supposed to be of Middle Bronze Age origin (Kuftin, 1950). Secondly, younger mounds where cultural layers start from ground level and the hill grows continuously over time (Papuashvili, 2005), fulfilling the criteria that define typical characteristics of tells (Menze et al., 2006).

Type 2: *Dikhagudzubas* are artificially constructed on top of much older settlements that were abandoned for a long period of time, with clear discontinuity in terms of cultural layers. Such hills are mostly dated to the Early Antique and Hellenistic periods (Mikeladze, 1978), thus significantly younger than the Bronze Age Type 1 mounds.

Type 3: *Dikhagudzubas* closely resemble Type 2, although no cultural layers are observed. While the artificial character of their construction is clear, the purpose of the construction of such kinds of hills is still unresolved (Papuashvili, 2005).

There is also another phenomenon of anthropogenic dwelling forms that can be found in Western Georgia, although its elongated shape and probable Early Iron Age origin evoke doubts as to whether they can also be classified as a certain type of *Dikhagudzuba* (Papuashvili, 2005). These hills occur during a time of cultural exchange and foreign impact, for example, by the Milesian Greeks (Braund, 1994).

As shown by archaeological excavations, in the case of the first two types of artificial hills, the construction techniques often involve an initial layer of wood logs, sometimes well-structured, in other cases quite diffused, which should be related to the swampy environment upon which the settlement mounds were constructed (Gogadze, 1982).

2.4 | Research areas

In this research, three settlement mounds (*Jojuebi*, *Guleikari* and *Namarnu 1*) were studied using the Aerial Photogrammetric Survey and SfM three-dimensional (3D) modelling, while another—*Orulu 2*—was studied concerning its stratigraphy and internal structure derived from sediment cores.

The *Jojuebi Dikhagudzuba* (E 41.6834, N 42.3597, diameter: 60–65 m, peak altitude: 5.7 m above sea level (a.s.l.), construction height: 2.3 m) is located in the area between the rivers Enguri and Khobistskali on the edge of the small village of Tsvane, about two kilometres south of the village of Ergeta, and 4 km south-west of the village of Orulu. *Jojuebi Dikhagudzuba* is currently used as a cemetery by the local village and is surrounded by a recently dry ditch, which is connected to the local drainage system. The symmetrical shape of the hill is distorted due to the artificial entrance road to the cemetery.

The other two settlement mounds *Guleikari* and *Namarnu 1* are located at the south-eastern edge of the study area (Figure 1). These are the most remote *Dikhagudzubas* from the shoreline, located ca. 50 km inland. *Guleikari* and *Namarnu 1* were archaeologically studied (Jibladze & Papuashvili, 2013; Kuftin, 1950), but only partly excavated. *Namarnu 1* is located on the southern banks of the Rioni, at a distance of ca. 2 km from the present river. It represents one of the largest of the studied settlement mounds, with a diameter close to 300 m. A farm is built on top of this large mound (E 42.1313, N 42.1325, diameter: 280–300 m, construction height: ca. 4.6 m) and it is partly surrounded by the segment of a wide moat, which seems to be nonfunctional nowadays.

The *Guleikari* mound is located in the same area in an open field, ca. 3.7 km west-southwest of the *Namarnu 1* mound. While the recent Rioni is located at a distance of ca. 2.5 km, the nearby oxbow indicates an initially close location to the river. The mound is partly overgrown by wild trees and bushes; it is surrounded by two circles of moats, thus representing another interesting example for analysis (E 42.1716, N 42.1172, diameter: 45–50 m, peak elevation: 14.2 m a.s.l., construction height: 1.8 m). The former moats are 15–20 m apart, one near the mound and the other one further away. Currently, they are quite shallow and almost dry with some swampy segments, which shows that they have not been used for a long time.

The settlement mound *Orulu 2* (E 41.7081, N 42.3933, peak altitude: 13.19 m a.s.l., diameter: ca. 35 m, construction height: ca. 2.85 m) is located between the rivers Enguri and Khobistskali in a garden area in the village of Orulu in the northern part of the central Colchian plain, less than 10 km inland from present coastline and covered by a hazel plantation. It is surrounded by a small ditch, with a maximum width of 1.5 m and a depth of <40 cm, directly in front of the hill foot. It has been part of the research presented by Laermanns, Kirkitadze, et al. (2018).

3 | METHODS

3.1 | Remote sensing

To identify the mounds' spatial structures and calculate their spatial dimensions and volume, remote sensing in the form of visual analysis of aerial and satellite images and Close Range Survey based on aerial photogrammetry was applied.

At first, well-known settlement mounds, usually mentioned in publications by relative geographical placements (orientation towards known objects) were precisely located by recognising the typical shapes of mounds on the terrain, or by verifying the provided geographical coordinates (Figure 1 and Supporting Information S1). Subsequently, remote geoarchaeological surveys were performed by screening the aerial and satellite images of the study area. This was to recognise and detect artificial hill shapes that are characteristic of settlement mounds. Satellite images from Google Earth and ArcGIS Basemap, covering the years 2006–2018 were applied, together with monochrome aerial Photos taken between 2000 and 2002 from the Land Cadastre of Georgia. Twelve previously unknown mounds were identified, which can be considered with high probability as archaeological features (cf. Supporting Information S1).

At the sites of the *Dikhagudzuba* mounds selected for this study, an aerial photogrammetric survey was conducted. An initial selection of survey sites was based on satellite and aerial images, to choose the sites less affected by vegetation cover and recent anthropogenic constructions, and therefore technically feasible for close-range aerial photogrammetric survey. However, in several cases heavy vegetation on-site was observed, giving a totally different impression compared to the expectations based on approximately 10-year-old satellite images. This raised the question of quite rapid changes in the landscapes (and particularly the vegetation) of the Kolkheti lowlands.

Altogether, the three settlement mounds *Jojuebi*, *Guleikari* and *Namarnu 1* (Figure 1) were recorded within an aerial survey combined with precise (order of centimetres) on-land measurements using differential GPS. In all three cases, special white poles were placed as Ground Control Points (GCP) on the site to ensure precise georeferencing of the created model (Westoby et al., 2012). Moreover, in the case of the *Guleikari* settlement mound, a full-scale DGPS survey was conducted to construct a clear Digital Surface Model (DSM). At each investigated site more than 100 overlapping photos were taken using a DJI Phantom 4 pro drone (Figure 2) equipped with a camera with a 1″ CMOS sensor 20 M FOV 84° 8.8/24 mm (35 mm format equivalent) f/2.8–f/11 lens, with every photo geotagged with coordinates and elevation above sea level.

To obtain high-resolution data sets at a range of scales, SfM techniques were applied by using Agisoft PhotoScan 1.2.4 (Westoby et al., 2012). Based on these data DSM and RGB orthophoto mosaics of the settlement mounds and their surroundings were created. Feature points between overlapping 2D images were correlated to calculate the position and orientation of the camera during the image acquisitions and to triangulate the 3D position of feature points itself (Plets et al., 2012; Verhoeven, 2011). To mitigate possible vertical offset, a correlation with the D-GPS-referenced Ground Control Points was obtained. By manual identification, the correlation of the GCPs' transformation from a relative to an absolute coordinated system was achieved, and a meshed 3D surface was generated without any additional software to triangulate the dense point cloud and orthomosaic generation (Westoby et al., 2012). For a calculation of the mounds' areas and volumes, the DSM and the orthophoto were exported and further analysed with the ArcGIS Spatial Analysis module and the Grid Calculator toolbox (Figure 4).

3.2 | Geochemical and sedimentological analyses

The stratigraphic analysis and geochemical interpretation of the settlement mound *Orulu 2* is based on sediment cores, which were taken using a Cobra TT (Atlas Copco) percussion coring device. Drilling was performed on the top, on the slope and at the forefront of the settlement mound (Figure 2). On-site the cores were photographed (Figure 3) and described, and different layers were defined based on their sediment texture, colour (with Munsell Soil Color Charts©) and $CaCO_3$ test (by using HCl, 10%). Samples were taken from sedimentary units vertically every 10 to 20 cm throughout the settlement layers and every 20–40 cm for the other parts of the core.

The granulometrical and geochemical analyses were conducted at the Geoscience Laboratory of the Institute of Geography,

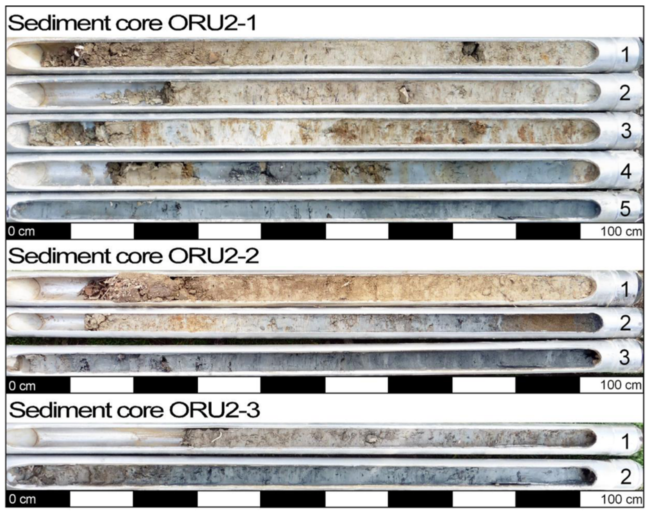

FIGURE 3 Sediment cores ORU2-1, ORU2-2 and ORU2-3, in 1-m-tubes each, from top left to bottom right (photos: Laermanns, 2015).

FIGURE 2 Fieldwork. (a) Preparing the DJI Phantom 4 pro drone (photo: G. Kirkitadze, 2018) (b) Drilling procedure with the Atlas Copco Cobra vibracoring hammer at the site of ORU2-2 on the slope of the settlement mound *Orulu 2* (photo: H. Laermanns, 2015).

University of Cologne. In preparation for further treatment, the samples were dried at 40°C in a drying chamber for 48 h, sieved to <2 mm and crushed gently with a mortar to disintegrate the aggregates.

Grain-size measurements were performed with a Laser Diffraction Particle Size Analyser (LS 13320 Beckmann Coulter™) in 116 channels from 0.4 to 2000 µm. The samples were pretreated with hydrogen peroxide (H_2O_2, 15%) to remove organic matter and with sodium pyrophosphate ($Na_4P_2O_7$, 46 g/L) to avoid coagulation. Each sample was measured three times using the optical Fraunhofer model. Grain-size parameters are based on Folk and Ward (1957) and were calculated by GRADISTAT software version 8 (Blott & Pye, 2001).

X-ray fluorescence (XRF) analysis was performed with a portable XRF analyser (NITON XL3t) to estimate the element concentrations. Therefore, the ground and homogenised (by the use of a Retsch MM 400 automatic ball grinder) material was pressed into 2-mm-thick pellets and measured three times per sample in the mineral mode for 160 s to cover all possible filter options. Interpretative analysis was conducted at the University of Nottingham.

For radiocarbon dating, three pieces of charred remains of terrestrial plants taken from sediment core ORU2-1 (settlement mound *Orulu 2*) were used (Table 1). The ages were calibrated using CALIB 7.1 software and IntCal13 data set (Reimer et al., 2013; Stuiver & Reimer, 1993).

4 | RESULTS

4.1 | Remote sensing

4.1.1 | Namarnu 1 Dikhagudzuba

Namarnu 1 is one of the largest *Dikhagudzuba* mounds on the Colchian plain (Figures 1 and 4). With a diameter of ca. 150 m, and of ca. 300 m including the large surrounding moats, it is larger than most other mounds of the region. The moat itself is about 70 m wide on average and 1.5–2 m deep. The mound covers an area of 20,000 m^2, which deviates from the typical circular shape. Its volume above the surrounding ground level was estimated to be ca. 36,000 m^3. Meanwhile, the moat occupies an area of about 45,000 m^2 and the calculations indicate a volume of approximately 40,000 m^3, with respect to the same average level value (11.7 m a.s.l.). This area of the moat is shown to be completely filled with water in a topographic map from the 1980s during the Soviet Era. The DSM (Figure 4) reveals clearly that the recent small channels cut even deeper into the ground of the moat area. Outside of the moat a circular wall-shaped elevation intersected by the channel outlets surrounds the area.

4.1.2 | Guleikari Dikhagudzuba

The adjacent *Guleikari* mound is much smaller compared to *Namarnu 1*, with a diameter of about 45 m and an area of 1800 m^2. Its volume above the surrounding ground level (12.8 m a.s.l.) was calculated to be approximately 3000 m^3; in fact, it will be even less due to dense vegetation, which significantly affected the DSM. The most significant aspect of this site is the two circular moats surrounding the mound (Figure 4). With 20–30 cm below the surrounding surface they are quite shallow. While the inner one with a diameter of about 60 m and a width of about 10 m is better expressed, the outer ditch is preserved only in the form of an incomplete circle, having a diameter of about 100 m and some 10 m in width.

4.1.3 | Jojuebi Dikhagudzuba

The perfectly circular *Jojuebi* mound has a diameter of 55 m. It covers an area of 2300 m^2, while the whole complex including the ditch is about 4900 m^2. Some sections of the ditch seem to have been filled with water in modern times. The ditch is filled up in the south-east to create road access to a cemetery that is located on top of the mound (Figure 4). The volume of the mound's construction is about 4000 m^3.

4.2 | Geochemical and sedimentological analyses at the *Orulu 2* settlement mound

4.2.1 | Sediment core ORU2-1

ORU2-1 was taken from the top of mound Orulu 2 and is described in Laermanns, Kirkitadze, et al., 2018. From its base at 5–4.53 m b.s., the sediment is poorly sorted greyish silty fine sand (mean grain size 25–40 µm) (Figures 3 and 5). The subsequent light grey silt layers (4.53–2.69 m b.s.) show decreasing Ca/K and Ca/Fe ratios. In the lower part (4.53–4.00 m b.s.), various plant remains occur with

TABLE 1 Radiocarbon data sheet. Calibration with Calib 7.1 software (Reimer et al., 2013, following Stuiver & Reimer, 1993).

Sample ID	Lab code	Depth below surface (m)	Material	$\delta^{13}C$ (‰)	Conventional ^{14}C-age BP	Calibrated ^{14}C-age (cal B.C.), 2 σ
ORU2-1/4	UBA-30020	0.68	Charcoal	−22.3	3497 ± 32	1907–1700 B.C.
ORU2-1/9	UBA-30021	1.77	Charcoal	−24.9	3550 ± 31	2008–1772 B.C.
ORU2-1/25	UBA-30022	4.26	Wood	−26.0	3891 ± 41	2474–2210 B.C.

Note: Dating was carried out at the ^{14}CHRONO Centre, Queens University Belfast (lab code: UBA), Northern Ireland, UK.

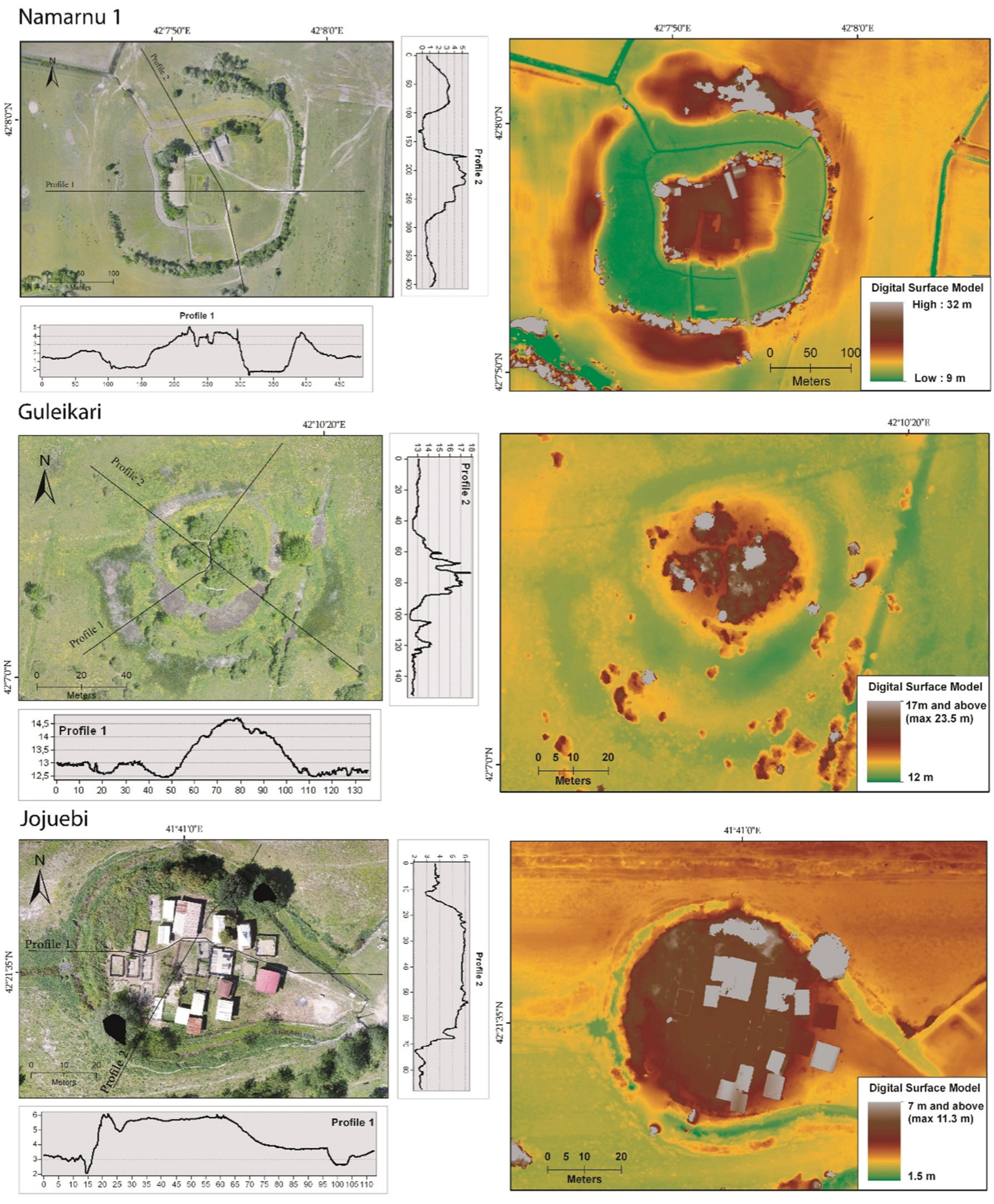

FIGURE 4 Orthophotos, D-GPS-measured elevation profiles and Digital Surface Models (DSMs) of the settlement mounds *Namarnu 1*, *Guleikari* and *Jojuebi*. The semisphere shape of the mounds is revealed, especially in the cases of *Gulaikari* and *Jojuebi*. The structure of the encompassing ancient moats is still visible. The trees as well as the farm (*Namarnu 1*) and the cemetery (*Jojuebi*) are reflected in the rounded and rectangular structures on the DSM.

relatively high values of S (up to 573 ppm), which are absent in the upper part (except from 3.50 to 3.27 m b.s.).

Measurement of levels of elements that could provide markers of anthropogenic activity (Cu, Zn, Pb, Fe, P, S) were analysed through the core to explore indications of the nature of human activity in the locality of Orulu 2 both before and during the use-life of the settlement. Indications of human influence in the locality that later became the settlement mound began before the first anthropogenic deposits associated with the deliberate raising of a settlement platform.

The first evidence of human use of the nearby landscape comes from alluvial deposits. At 3.225 m b.s, there are significant rises in the level of P and rises in the levels of Cu, Zn and a minor rise in Pb. The high P is consistent with the use of the area for grazing and corralling

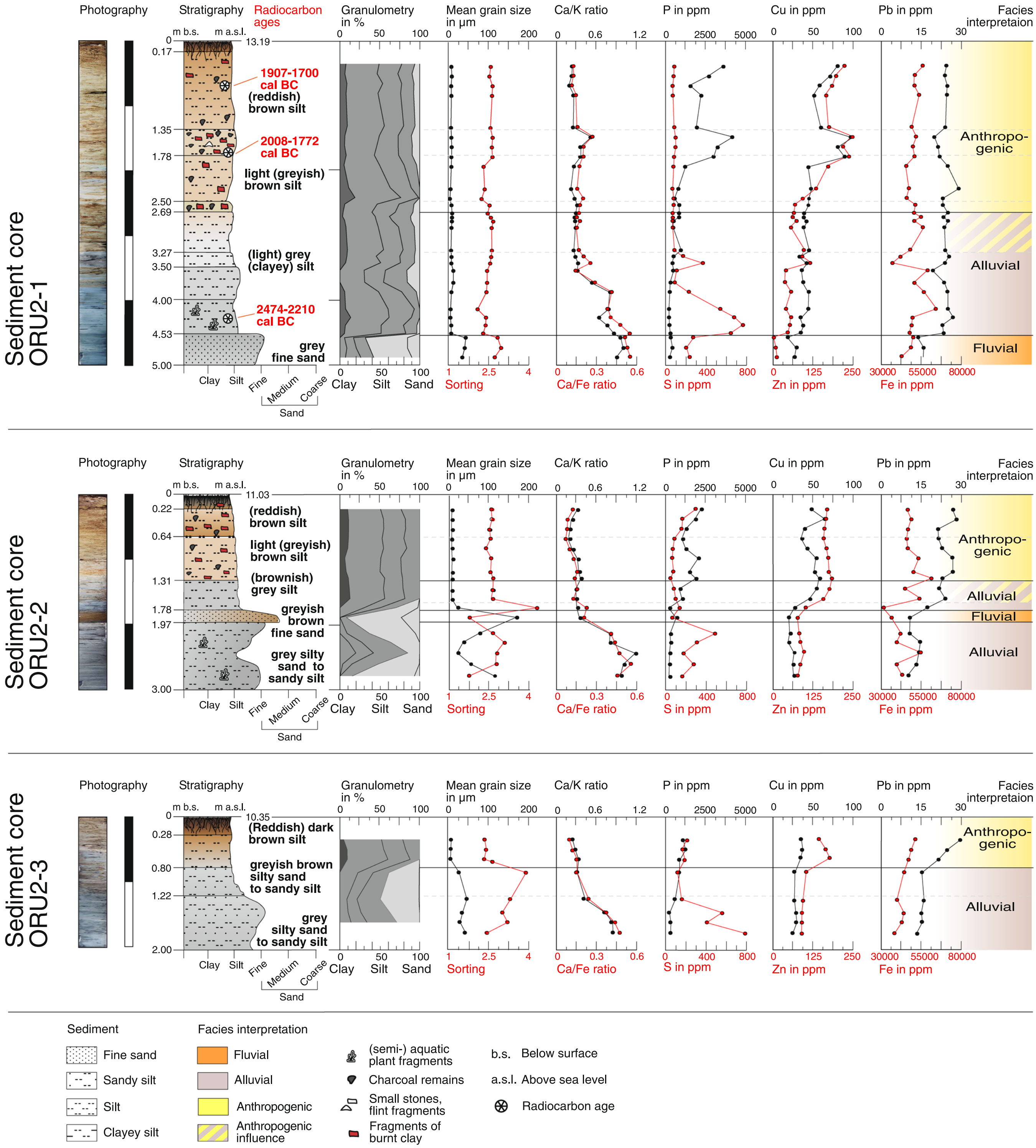

FIGURE 5 Profile, granulometry, geochemistry and facies interpretation of the sediment cores ORU2-1, ORU2-2 and ORU2-3. Their stratigraphy consists of alluvial and fluvial layers in the lower part and anthropogenic deposits above. The latter can be easily separated by granulometry and geochemistry.

livestock and/or human occupation in the area, perhaps of a temporary, seasonal nature. No pottery or charcoal was associated with this sample. The elevated levels of Cu and Zn are consistent with pollution from copper smelting, which also released Zn and Pb as impurities from the ore. This metalworking pollution need not have resulted from metalworking in the immediate area. It could have been undertaken further up the river catchment, to be deposited at Orurlu 2 in over-bank flooding/alluviation.

Intermittent or no significant use of the location for pastoralism/seasonal use is suggested by low levels of phosphorous from the alluvial deposits between 2.775 m b.s and 2.720 m b.s. However, a high P at 2.715 m b.s suggests renewed exploitation for grazing or corralling of livestock and/or human occupation. Although, again, indications of stable permanent settlement (such as burnt clay and charcoal) were absent from this alluvial horizon.

From 2.69 m b.s. to the surface were several light brownish grey strata with changing contents of charcoal flitter and burnt clay fragments, marking the deliberate raising of a settlement mound. Despite this deliberate human action to elevate the site for settlement, its level of P was no higher than in the alluvial deposits at 3.225 m b.s and was very similar to the level at 2.715 m b.s. No metalworking is reflected in this horizon. Between 2.525 m b.s and 2.425 m b.s levels of P fall again and evidence of metalworking is all but absent, despite the deposits being part of the settlement mound.

From 1.92 m b.s. there is a distinct change in the geochemical profile of the deposits. From that depth to the surface, the measurements of P are consistently over 1200 ppm, and most levels range from 2000 to 3000 ppm. These measurements seem to mark the intensive permanent use of the mound for settlement/livestock storage. From 1.775 to 1.475 m b.s, there are peaks in Cu and Zn (with low Pb), suggesting the working of copper-alloy on the settlement. The level of metalworking was not continuous through time, however; as Cu and Zn levels dropped between 1.475 and 0.525 m, until a renewed rise between 0.525 and 0.375 m b.s in the uppermost occupation layers of the mound. The highest levels of P also occurred between 1.775 and 1.475 m b.s and between 0.525 and 0.375 m b.s. (but with very low Pb). Pb is only above average (at 24+) from ORU2/6 (132.5 m b.s.) to ORU2/2 (37.5 m b.s.). The highest phosphate concentrations are 177.5 to 147.5 and 52.5 to 37.5 m b.s.

Despite these evident changes in the intensity and nature of activity within the activity- and occupation-sequence on the site, the mean grain size, Ca/K, Ca/Fe and S ratios remained at constantly low levels without remarkable changes. At a depth of 1.62 m, a flint flake of 3 cm was found (Laermanns, Kirkitadze, et al., 2018).

4.2.2 | Sediment Core ORU2-2

ORU2-2 was taken from the slope of the settlement mound Orulu 2 (Figure 2). The lowermost part between 3.00 and 1.97 m b.s. consists of heterogeneous and rather poorly sorted grey silty sand to sandy silt, with a varying mean grain size between 20 and 120 µm. Furthermore, these layers stand out with the occurrence of few plant fragments and elevated S values (Figure 5). Between 1.97 and 1.78 m b.s. homogeneous greyish fine to medium sands (mean grain size ~170 µm) were deposited. Here, Ca/Fe and Ca/K ratios, S, Cu and Zn concentrations are low. The greyish brown silt between 1.78 and 1.31 m b.s. differs in its poorer sorting. There are also, as in ORU2-1, some indications of human activity in the locality from some of the alluvial deposits. For example, at 1.60 m b.s the level of P rises to over 1000 ppm and this rise is accompanied by marked rises in Cu, Zn and some elevation in Pb. The uppermost part of greyish to reddish brown silts, from 1.285 to 0.225 m b.s., are characterised by high values of P (all over 1000 ppm); they also contained several charcoal flitters and fragments of burnt clay. Levels of metal pollution are not consistently high, however. There are two special peaks in Cu and Zn from 1.445 to 0.975 and from 0.375 to 0.225 m b.s. These Cu/Zn peaks are mirrored by peaks in Pb from 1.185 to 0.975, and from 0.375 to 0.225 m b.s. These metal peaks mark two particular rises in copper-alloy working on the settlement, also seen in ORU2-1.

4.2.3 | Sediment Core ORU2-3

In contrast to the two other drilling sites, this sediment core was taken at the forefront of the settlement mound within a distance of ca. 3 m from its foot. It consists of heterogeneous silty fine sand to sandy silt with a decreasing mean grain size towards the top, between its maximum depth of 2.00 and 0.80 m b.s. Simultaneously with a drop in grain size, the concentrations of S, Ca/Fe and Ca/K ratios also drop. The reddish-brown silt deposited between 0.80 m b.s. and the surface is characterised by elevated values of P and a high Pb concentration in the uppermost part of the mound at 0.335 m b.s.

5 | DISCUSSION

5.1 | Distribution, dimension and external structure of the mounds

As indicated by the GIS surveys, all investigated settlement mounds reveal a similar pattern concerning their current occurrence and location. All of them are located on the flat and fertile alluvial plain in close proximity to recent rivers and/or palaeo-riverbeds, which is revealed by the aerial and satellite images (Figures 1 and 4). These waters and their beds vary from small brooks to the current river Rioni. Furthermore, it is shown that most mounds are arranged in groups and in relative proximity of less than three kilometres from one other (cf. Jibladze & Papuashvili, 2013; Tsetskhladze, 1997).

The mounds have a circular, conical shape and their diameter spans in general from ca. 35 m (*Orulu 2*) to ca. 55 m (*Jojuebi*), resulting in an area from roughly ~1000 m^2 (estimated for the smallest analysed mound *Orulu 2*) to ~2300 m^2 and a volume between ~3000 and 4500 m^3. An exception is the *Namarnu 1* mound; it has far bigger dimensions that fulfil the description of a central, major mound (Jibladze & Papuashvili, 2013; Tsetskhladze, 1997), although it is located on the western edge of a group of four mounds, including *Guleikari Dikhagudzuba*. The non-linear distribution of these four mounds seems random concerning the recent course of the Rioni. However, considering the oxbows that indicate the former course their location is much more plausible.

Besides its size, *Namarnu 1* stands out with an irregular and rectangular shape that contrasts the circular accumulation that it probably had originally (Figures 4 and 7). It is caused by its recent use as a construction site for farm buildings. Comparable, but less significant modifications can be seen at *Jojuebi*. Here it looks like a ramp was built to facilitate the access to the recent graveyard that was installed on the mound. Overall, many of the *Dikhagudzubas* are comparably affected due to enduring anthropogenic use over millennia, especially by the foundation of graveyards, since these elevated areas are inherently perfect conditions within the swampy surroundings of the Colchian plain. These constructive interventions, and in many cases the dense vegetation cover, either naturally or planted, reshaped the original figure of the mounds and in some cases hindered an easy identification. In particular, this becomes clear in the case of the *Durghena Dikhagudzuba* (Supporting Information S1: Figure B) where satellite pictures reveal how quickly vegetation cover can change within 8 years.

Comparably affected by enduring land use and erosional processes are the characteristic moats that surround the mounds, which explains their different states of preservation. While in the case of *Orulu 2*, no traces of the original moat are evident (only a small modern ditch was found; Figure 6), all other analysed cases reveal clearly the existence of one (or even more) circular moat structures. Despite all natural and anthropogenic adverse effects, it is possible to calculate an approximately equivalent amount of sediment for the accumulation form of the mounds and the depressions of the moats, which indicates that the mounds' material was taken from their surrounding areas. Where the connection of the moats to adjacent (palaeo-) channels has remained their location along riverbeds is confirmed.

5.2 | Internal structure of the mounds

5.2.1 | Facies interpretation

In addition to the external setting of the mounds, their internal structure and the foundation ground were deciphered. Different facies were classified based on the geochemical and sedimentological data. The anthropogenic layers of the settlement mound could be easily separated from the natural deposits below. Altogether three facies were defined:

Facies 1: Fluvial (channel deposits)

These interdigitated strata typically consist of poorly sorted sandy silt to silty sand with a thickness of several decimetres. Sorting values of ~1.5–3 were found in the lower parts of the sediment cores ORU2-1 and ORU2-2; they are easily separated by sharp boundaries from the surrounding deposits. While the coarse mean grain size indicates the high energy of a fluvial deposition, which is typical for channel deposits in the floodplain environment (Boggs, 2006; Sun et al., 2002), the low contents of Cu, Zn, Pb and P reveal no indicators for anthropogenic activities (Figure 5), for example, of metallurgy and agriculture (Miller et al., 2014; Nicosia et al., 2013).

Facies 2: Alluvial (floodplain/overbank deposits)

It consists of heterogeneous silts with a varying content of sand. It is characterised by comparably high Ca/Fe and Ca/K ratios, which decrease with depth. The elevated ratios can be considered as markers for aquatic conditions, in this case, combined with the grain size and alluvial conditions (Davies et al., 2015). Peaks of S in the lower parts, often accompanied by elevated Fe concentrations, are possible indicators for anoxic conditions (Aufgebauer et al., 2012;

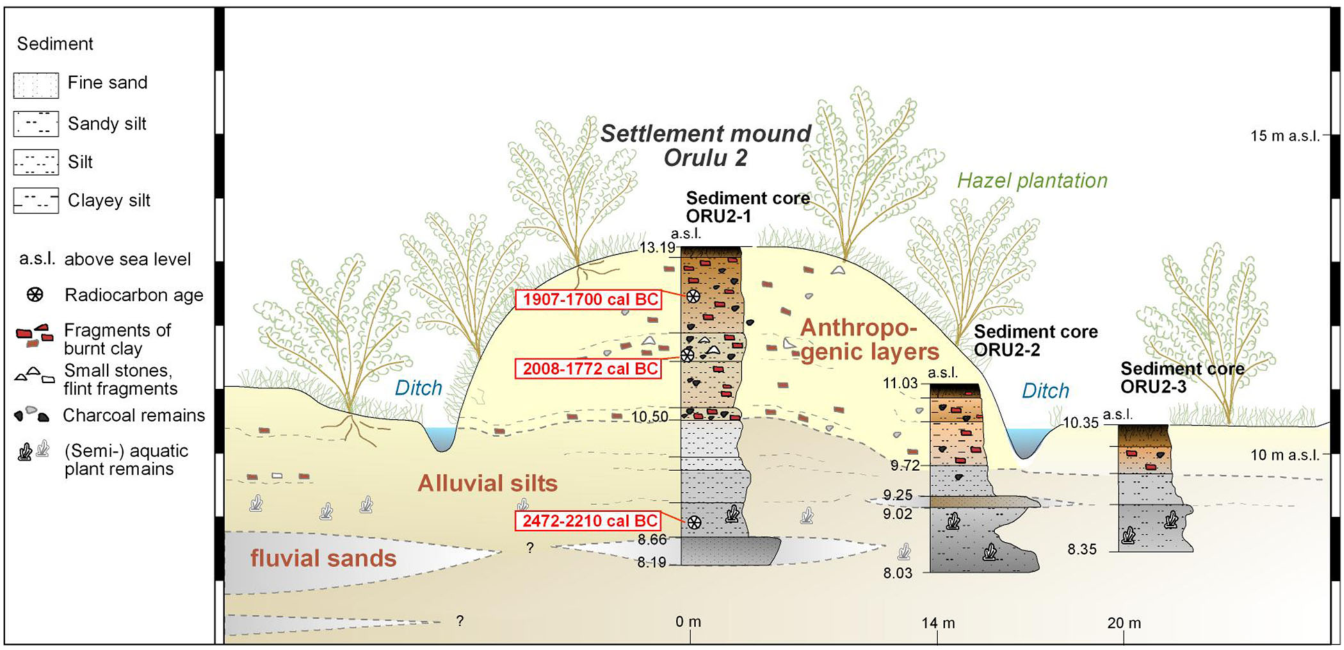

FIGURE 6 The schematic cross-section of the settlement mound *Orulu 2* indicates the succession of fluvial and alluvial deposits and the subsequent anthropogenic construction of the mound. *Source*: Laermanns, Kirkitadze, et al. (2018, modified).

Kylander et al., 2011), which would reflect typically swampy wetlands and varying hydrodynamics from freshwater input to stagnant water bodies and (flooded) plains. The general decline of Ca/Fe and Ca/K (Figure 5) in the uppermost parts of Facies 2 may indicate an increase in detrital input and intensification of physical weathering (Arnaud et al., 2016; Kylander et al., 2011; Mueller et al., 2009).

In ORU2-1 and ORU2-2 there were indications of likely anthropogenic activities within some of the alluvial deposits before the creation of the basal layer of the raised settlement mounds. These likely anthropogenic markers included rises in levels of P, Cu, Zn and occasionally Pb at certain depths, most notably at 3.225 m b.s. The occurrence of elevated levels of these elements in alluvial deposits suggests the use of the immediate locality and site of the later settlement mound for periodic human settlement, intensive grazing or corralling of livestock (Loveluck & Salmon, 2011; Loveluck et al., 2014). The periodic rises in Cu, Zn and Pb could reflect nearby copper-alloy working or pollution from further up the river catchment being deposited by overbank flooding in the alluvium.

Facies 3: Anthropogenic

Although the silt-dominated granulometry of Facies 3 is similar to the alluvial deposits below, it can be easily separated in the case of the sediment cores ORU2-1 and ORU2-2 by a sharp boundary from the underlying alluvial deposits. However, the likely anthropogenic markers in some of the alluvial deposits suggest that we should make a distinction between the onset of the use of this resource-rich landscape in the mid to late third millennium B.C., on the one hand; and on the other, the onset of permanent settlement within it on settlement mounds, predominantly dating from the late second millennium B.C. in the Mid to Late Bronze Age. In the case of ORU2-3, there is a more gradual transition from Facies 2 to Facies 3. The sediments of the latter facies are rich in burnt clay flitters and charcoal remains. Although there were no diagnostic artefacts found, but only a flint flake (see Figure 5), this confirms the anthropogenic influence. The continuously low Ca/K and Ca/Fe ratios and S concentrations suggest terrestrial, non-swampy conditions (Davies et al., 2015; Kylander et al., 2011). The marked peaks in Cu and Zn and occasionally Pb, hint at significant copper-alloy metallurgy in certain periods (Guyard et al., 2007; Miller et al., 2014; Oonk et al., 2009; Šmejda et al., 2018), especially at the centre of ORU2-2 (Figure 5). There the highest P concentration occurs, which indicates agriculture and animal husbandry (McLauchlan, 2006; Nicosia et al., 2013; Šmejda et al., 2018), since—due to its relative immobility—P is often used to identify ancient farming sites (Dupouey et al., 2002; Eidt, 1977; Holliday & Gartner, 2007). In summary, these parameters reveal a high anthropogenic influence, clearly separating Facies 3 from the layers below.

5.2.2 | Chronostratigraphic scenario for the settlement mound *Orulu 2*

The *Orulu 2 Dikhagudzuba* was founded on alluvial sediments. As we know from former studies (Laermanns, Kirkitadze, et al., 2018) these strata consist of several alluvial deposits and overbank fines (Facies 1) that are interdigitated with coarser fluvial deposits (Facies 2)—a typical succession for coastal alluvial plains (Boggs, 2006). The radiocarbon dating of plant fragments in sediment core ORU2-1 at a depth of 4.26 m b.s. indicates an age of 2474–2210 cal B.C., that is, floodplain conditions since at least the mid-third millennium B.C. (Figure 6). There are good arguments that they have evolved earlier, at least before 3500 B.C. (Laermanns, Kelterbaum, et al., 2018). On top of the natural layers, anthropogenic deposits (Facies 3) were accumulated.

In the case of the settlement mound *Orulu 2*, the oldest dated layer of the human-raised platform yielded an age of the early second millennium B.C. (2008–1772 cal. B.C. at 1.77 m b.s.). Another sample taken from a depth of 0.68 m b.s. dates back to 1907–1700 cal. B.C. and indicates that the different single layers of construction are of comparable age, possibly even originating from the same construction phase (Figure 6). This deliberate construction of the settlement platform followed geochemical evidence for earlier phases of human activity (but not permanent settlement) on the site or in its immediate vicinity sometime between the mid-third and the early second millennium B.C. The volume of the circular moat around Orulu 2 matches the roughly estimated volume of the mound, supporting the theory that it was the source of the mound's construction material. This construction resembles the many other mounds where similar encircled dwelling forms remained (cf., e.g., Figures 4 and 7).

FIGURE 7 Structure-from-Motion three-dimensional model of the mound and surrounding area based on the aerial images (cf. Figure 4), processed with Agisoft Photoscan.

5.3 | Palaeoenvironmental context and geoarchaeological implications

Using modern geoarchaeological field and laboratory methods the *Dikhagudzubas* can be seen in their environmental context. Corings revealed the distinct border between the natural, i.e. alluvial floodplain sediments and the anthropogenic layers of the mounds. This floodplain evolved following the deceleration of the Black Sea level rise since ~5000 B.C. (Brückner et al., 2010; Giosan et al., 2009). Thus, a major transition from lagoonal to semi-terrestrial environments occurred between ~3500 and ~1500 B.C., causing the formation of vast peat bog areas and the gradual shift toward a swampy coastal plain (Laermanns, Kelterbaum, et al., 2018). Beyond doubt, this transition was primarily forced by the enduring sediment supply of the Rioni and the other rivers running down from the Caucasus foothills. The increasing share of solid ground forced a regression of water bodies and opened the access for settling this region.

The palaeogeographical evidence is in accordance with palynological results presented by, for example, Connor et al. (2007) and de Klerk et al. (2009), who consider the climate of the Early Bronze Age in general as warm and humid. Besides minor variations, they indicate dominating peat land vegetation, triggered by fluctuating groundwater conditions caused by an interaction of sea-level rise and fluvial infill interspersed with open woodland. This data corroborates with ancient sources, such as Hippocrates (ca. 460–ca. 370 B.C.) and Strabo (64/63 B.C.–ca. A.D. 24) who both describe the surroundings of the ancient Phasis at the river mouth of the Rioni as marshy forests and swamps, where people used to move around in small boats along channels (cf. Gamkrelidze, 2012). In these conditions where rivers and channels seem to have been communication axes and transport is supposed to be easier by boat than on swampy footpaths, it seems plausible that the mounds were erected close to the Rioni and smaller rivers.

Obviously, such swampy conditions forced people to create artificial dry places for enduring occupation—comparable with the situation today where only drained areas on the Colchian plain can be occupied. Therefore, the intentional construction of mounds and surrounding circular moats for building material and drainage purposes are reasonable. Thus, the vicinity of rivers will have been of crucial significance to forward the discharge via the connecting channels.

However, such a humid climate in a coastal plain allows for comparisons to other coastal regions or alluvial plains where people built comparable dwelling forms as foundations of their houses or settlements, for example, in Frisia (the Netherlands and Germany) and along the Danish coast (Ervynck et al., 2012; Haas & Schepers, 2022; Nieuwhof et al., 2019; Schepers & Behre, 2023). Besides the environmental conditions, the small age difference between the radiocarbon ages within the mounds' stratigraphy (cf. Laermanns, Kirkitadze, et al., 2018) and the absence of a sequence of settlement and destruction layers, makes an intentional construction seem most plausible.

Although most of these results from fieldwork are in accordance with the archaeological reports, several aspects are still inconsistent. Thus, it remains challenging to precisely classify if the analysed mounds can be regarded as Type 1, 2 and 3 according to the scheme established by Jibladze and Papuashvili (2013). Although mound *Orulu 2* can be dated to the Early Bronze Age, a classification as Type 1 *Dikhagudzuba*, typical for that period, is ambiguous. The irregular occurrence of brick and charcoal remains with slightly elevated concentrations at 2.69-2.50 and 1.78-1.35 m b.s. within the sediment core ORU2-1 (Figures 3, 4 and 7) may hint at possible occupation layers. However, the periodic indications of use of the location before the construction of the settlement mound from the geochemical analysis, and the fluctuating intensity of use of the settlement for certain activities, such as metalworking, further endorse a Type 1 classification. Yet, a clear definition of the occupation layer is to be questioned due to the similar ^{14}C ages within the layer and above, which indicate a rather fast accumulation. However, the small diameter of vibracores can only render limited information. Furthermore, no implications of a significant wooden layer as foundation ground as described by Jibladze and Papuashvili (2013) was found—neither in the sediment cores taken from the settlement mound *Orulu 2* (Figures 5 and 7) nor in cores from the other studied mounds *Orulu 1* and *Ergeta 1* (Laermanns, Kirkitadze, et al., 2018). Possible explanations might be, once again, the method of vibracore-drilling, the possible dissolution of the wooden beams, and the slightly elevated location of the mounds that would make a wooden foundation dispensable. Beyond that, the contradictive information of some older publications that were summarised by Jibladze and Papuashvili (2013) must also be considered with caution. To test those assumptions and to achieve a clear classification of the mounds, an archaeological excavation would be needed for final proof.

And lastly, it is worth mentioning that the complex terrain of the South Caucasus supported the development of distinct cultures in localised areas, which were adapting to the local environment. The present study adds new data to a wider picture of the palaeoenvironment and human adaptation in the region. In the Late Bronze Age, Colchis was bordered by the Lchashen-Tsitelgori culture to the East (Sagona, 2018). Recent geoarchaeological studies in the Shiraki Plain of the South-eastern Caucasus also show evidence of active changes in the environment, which occurred in the Middle/Late Holocene, dominated by aridification and diminishing water resources (von Suchodoletz et al., 2022), differing from what we observe in Colchis.

6 | CONCLUSIONS

For the first time, a comprehensive summary of Georgian literature and archaeological investigations on the Colchian *Dikhagudzuba* mounds of the Colchian plain could be given. Further, the position and scientific processing status of each known mound could be listed (cf. Supplementary Material). The mounds occurred since the Early Bronze Age when sufficient sediments were deposited by the Rioni and its adjacent rivers to form an alluvial coastal plain where (semi-) dry conditions dominated peat bogs and lagoonal lakes and promoted occupation. Using remote sensing typical patterns were identified. The mounds are located, mainly in groups, alongside recent or former rivers, which may be seen as central axes of transport and communication to the Colchian people. The mounds were erected on a fine-grained alluvial foundation, and reveal an (at least originally) circular, semispherical shape of 35–55 (exceptionally 150) m in diameter and an altitude between 1 and 10 m above the surrounding plain. As such they cover a surface area of between ~1000 and 20,000 m^2 on average (exceptionally 40,000 m^2). Their stratigraphy hints at an intentional accumulation, a theory that is endorsed by the location in the alluvial coastal plain and the warm and humid climate conditions at the time of the mounds' construction during the Early Bronze Age (first half of the second millennium B.C.). They reveal a likely transformation from periodic use for transhumance or seasonal settlement in the locality to the construction of the mounds and permanent occupation. They may contribute to a general understanding of the transition of Bronze Age societies and land use during that time (Stephens et al., 2019). Nevertheless, archaeological excavation would be needed to clarify remaining questions and verify or falsify opposed assumptions from Georgian sources based on surveys undertaken in the second half of the 20th century.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Zenodo at https://zenodo.org/deposit/8338181.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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