# TRACES OF COMPLEXITY

## STUDI IN ONORE DI ARMANDO DE GUIO
## *STUDIES IN HONOUR OF ARMANDO DE GUIO*

a cura di
LUIGI MAGNINI, CINZIA BETTINESCHI, LAURA BURIGANA

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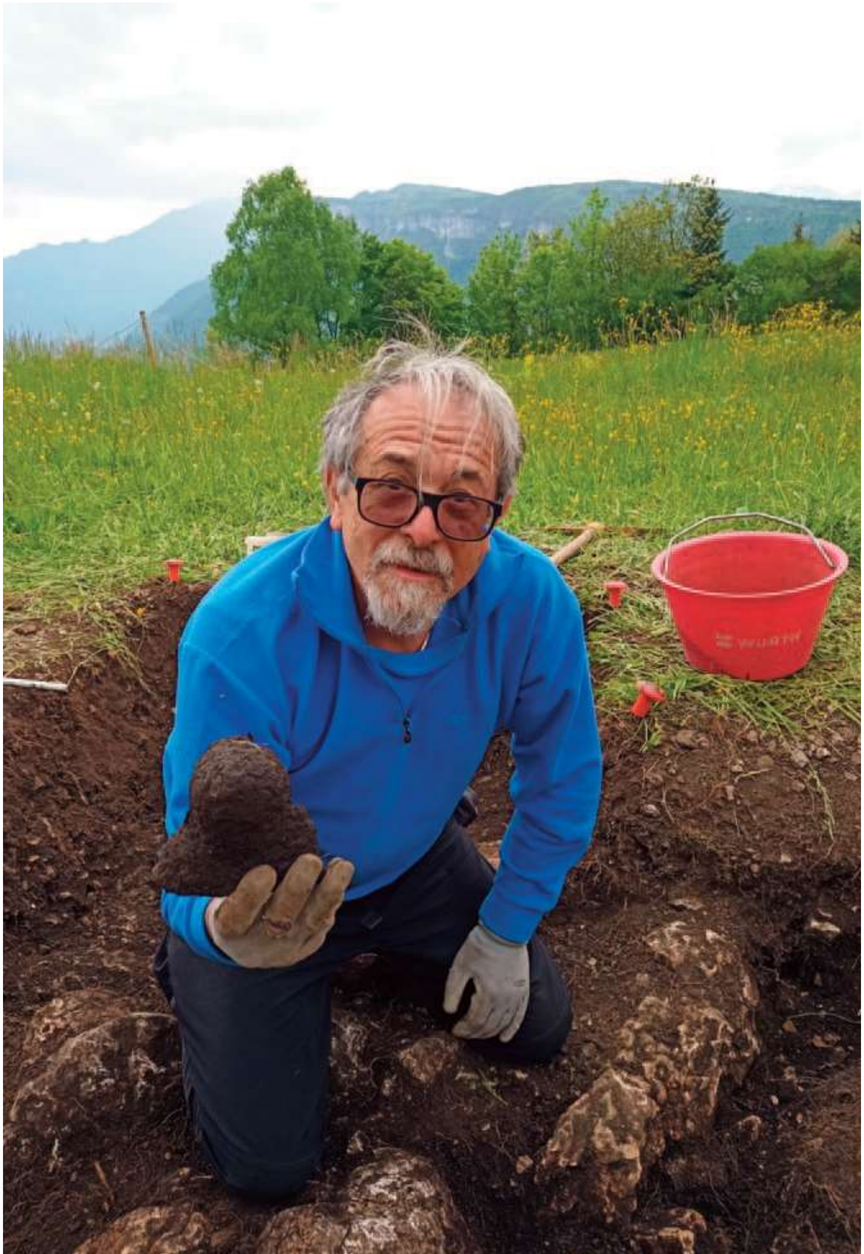
# INDICE | SUMMARY

**Artifacts and ecofacts**



**High-tech, high theory**



MICHELE BASSETTI, ELISABETTA MOTTES, MATTIA SEGATA, PIETRO ZANONI, DIEGO E. ANGELUCCI

# INTO THE GROOVE. AN EXPERIMENTAL APPROACH TO ARD-MARKS EVIDENCE IN CULT AREAS: THE CASE OF THE BRONZE AGE SITE AT GARDOLO DI MEZZO (TRENTO, ITALY)

## 1. Geographical background[1]

The archaeological site of Gardolo di Mezzo (350 m asl) is located in the central-eastern part of the southern region of the Alps, on the left side of the Adige Valley, about 5 km north of the town of Trento (fig. 1A). The archaeological area is located on a terrace 150 m above the present-day valley floor, which is naturally protected to the north and the south by ravines formed by two watercourses.

The site stretches out over a slight morphological depression with a NW-SE orientation, delimited to the east by the western slopes of the Doss de la Luna (415.5 m asl). The bedrock is made up of carbonate rocks belonging to the Triassic formation of the *Dolomia Principale*, while the local morphology is basically influenced by a set of NW-SE faults related to the so-called Calisio Line.

## 2. Research background

The research carried out at Gardolo di Mezzo from 2003 by the Archaeological Heritage Office of the Autonomous Province of Trento's Cultural Heritage Department has made it possible to bring to light an extensive multi-layered archaeological area divided into seven distinct sectors (Garm 1-7) (fig. 1B).

The evidence relating to the settlement is situated along the western slopes of the Doss de la Luna (Garm 1 and 3) and covers a chronological period between the Copper Age and the Recent Bronze Age in according to the Italian chronology.

To the west of the inhabited area, the presence of a cult area has also been documented (Garm 2, 4, and 5) and in particular two monumental *tumuli* (Tums. 1 and 2, from now onwards), which experienced several phases of renovation works (fig. 1C). The stratigraphic data and the radiometric measurements available make it possible to date use of this area to between the beginning of the Early Bronze Age (Polada A locally) (Perini 1990a, pp. 233-234; Mottes, Nicolis 2019, pp. 198-199) and the Recent Bronze Age (Mottes, Bassetti, Silvestri 2011; Mottes, Nicolis 2019, pp. 203-205).

In the immediate vicinity of the settlement and cult area it has also been possible to document the presence of evidence relating to graves and primary metal production dating back to the Copper Age (Garm 6, corresponding with Riparo Marchi) (Mottes *et al.* 2014; Mottes, Nicolis 2019, pp. 196-197) and of a necropolis from the final phases of the Bronze Age, attributable to the Luco/ Laugen A Culture (Garm 7) (Mottes, Bassetti, Maggioni 2017; Mottes *et al.* 2021).

In the area with the tumuli (Garm 2) several cobbled surfaces have been documented, presenting ard-marks relating to different moments of occupation of the site, from the most ancient phases.

The aim of this paper is to present the preliminary results of the experimental approach to Bronze Age ploughing at the Gardolo di Mezzo site. This approach is based mainly on statistical processing of the changes to the fabric of the pebbles before and after ploughing[2].

[1] In this paper chapters 1 and 4 have been written by M. Bassetti, chapter 2 by E. Mottes, chapters 3 and 7 by E. Mottes and M. Bassetti, chapter 5 by M. Bassetti, M. Segata, P. Zanoni and D.E. Angelucci and chapter 6 by M. Bassetti, M. Segata and P. Zanoni. The figures and photographs have been drawn up and designed by CORA Società Archeologica srl - Trento. English text revision by Vivienne Frankell.

[2] An earlier version of this study were presented at the International Symposium of the Austrian Society for Prehistory and Early History (ÖGUF) held in Vienna on 27-30 October 2010 (Bassetti *et al.* 2010).

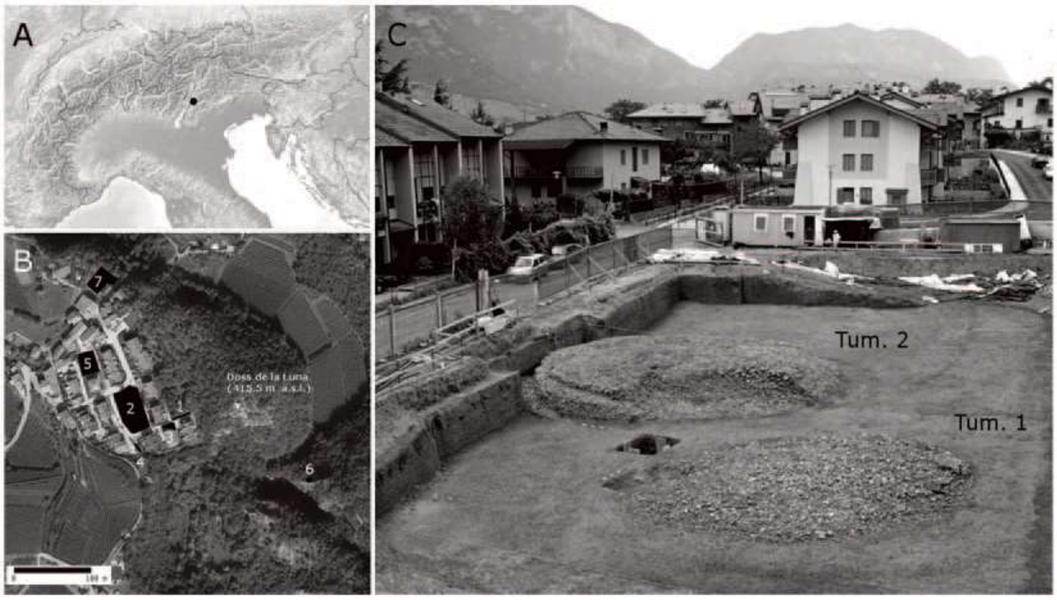



*Fig. 1. Gardolo di Mezzo (Trento). A. Site location. B. Excavation sectors. C. View of sector Garm 2 from the south.*

### 3. Stratigraphic succession and the tumuli building techniques

The geoarchaeological survey undertaken in the sectors Garm 1-5 has made it possible to reconstruct the sedimentary evolution of the deposit. The following main events can be noted:

- The bedrock was covered with sand and gravel from glacial melting following the Alpine Last Glacial Maximum.
- During the climatic improvement that took place with the onset of the Holocene, forest soil developed over the sand and gravel deposit, indicating substantial stabilisation of slopes.
- Before extensive human intervention on the environment, a phase of hydrogeological instability began and continued till the Middle Ages. The slopes were furrowed by deep erosion and the morphological depression which was to be chosen as the cult area was gradually covered by thick colluvial deposits.
- To the north of the settlement and cult area, extensive reclamation work and management of the slopes was performed in order to restrain the flow of sediment towards the valley.
- After the establishment of the cult area, slope activity continued and the colluvial deposits gradually buried the tumuli. This led to repeated reconstruction of floor surfaces and the raising of structures in order to avoid the complete obliteration of the tumuli.

In the Garm 2 sector, where the tumuli were found, a cyclical stratigraphic sequence was detected, with a thickness of around 4.5 m, made up of colluvial layers alternating with anthropic features. The renovation of the tumuli involved a series of human activities over time, activities that can be summarised as follows:

- ploughing of the colluvial sediments accumulated in the area around the ancient structure;
- laying of pebbles on the newly prepared ground along the belt surrounding the platform;
- establishment of a platform and a perimeter structure made of cobbles and subrounded blocks taken from the site's glacial-contact (fluvioglacial) sediments - gravel mainly consisting of volcanic rock types with a sandy matrix;
- construction of an earth covering, of which limited remains have been found.

A specific pattern for distribution of the pebbles was noted in every stratigraphic phase of the colluvial units. The pebbles were laid out in a linear pattern or in parallel bands, often at equal distances. The linear bands are generally discontinuous but can also reach a length of several metres (fig. 2A). Furthermore, the linear bands surround the perimeter of the platforms and are oriented in a different way. In some specific areas, they cross one another.

Within this pattern, the pebbles tend to be oriented according to their major axis (*a*) and major plane (*ab* – see below). Furthermore, some pebbles are arranged vertically. In cross-section, they appear to be positioned along sloping surfaces, up to a maximum depth of 25 cm (fig. 2B). In the area of the findings, it was often possible to note parallel furrows in the underlying cobbled surfaces, at a

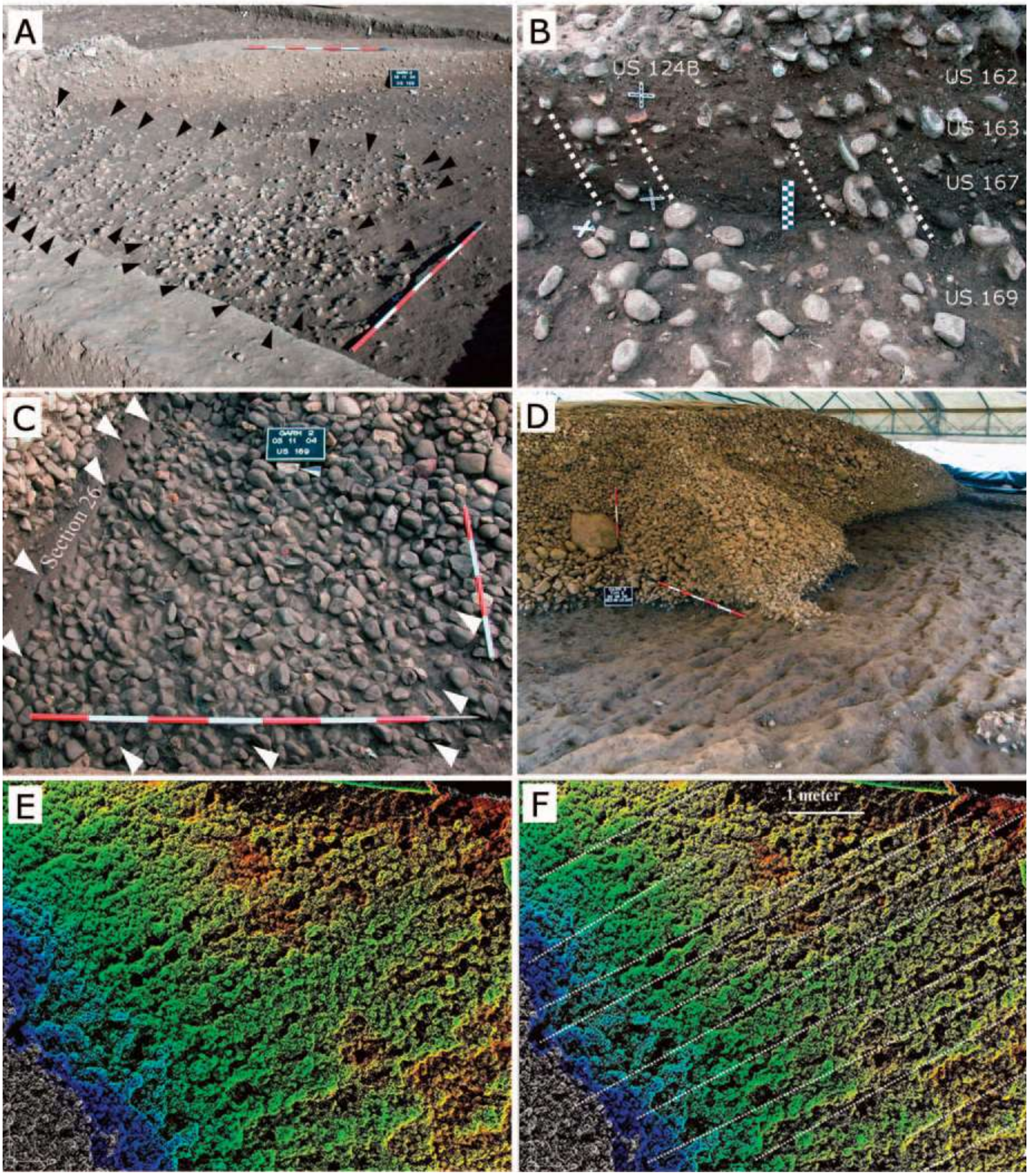



*Fig. 2. Gardolo di Mezzo (Trento). A. View of the upper surface of US169. Interpretation of ard-marks (black arrow). B. View of cross-section 20 with interpretation of the stratigraphy and of the ard-marks (white dashed lines). C. Detail of the upper surface of US 169. Interpretation of ard-marks (white arrow). D. Ard-marks preserved on top of the colluvium US 167=298, near Tum. 2. E. Partial 3D laser-scan of the upper surface of US 169=294. F. Interpretation of ard-marks (white dashed lines).*

distance varying from 30 to 50 cm and with an average width of around 15 cm. Inside the furrows the pebbles tended to be iso-oriented (figg. 2C-D-E-F).

Through data processing it has been possible to exclude specific geomorphological dynamics such as slope erosion, frost action and karst-related phenomena as the processes responsible for such a pattern.

It is therefore likely that the evidence identified may be the result of ploughing. Ard-marks are reported in European archaeological literature in various contexts, especially beneath burial mounds (Leonini 2018 and bibliography cited there).

In the southern zone of the Alps, ard-marks have been documented in burial and cult areas chronologically dating from the Middle/Late Neolithic to the Copper Age, in particular at the sites of Canton at Trescore Balneario (Bergamo) (Poggiani Keller 1998; 2004, pp. 108-109, 114, fig. 3; 2006), Saint-Martin-de-Corléans at Aosta (Mezzena

1997, pp. 70, 88-91, figg. 51-53; Ferroni *et al.* 2018, pp. 163-165), Cemmo di Capo di Ponte (Brescia) (Poggiani Keller 2009, p. 213, Fig. 2) and Velturno/Feldthurns, località Tanzgasse (Bolzano/Bozen) (Dal Rì, Tecchiati 1994, pp. 15-16, Fig. 5; Dal Rì *et al.* 2004, Fig 13).

## 4. Stratigraphy and micromorphological analysis. The example of section 26

Microstratigraphic analysis was carried out in section 26, because it is close to the test area of the unit of stratifications (US, from now onwards) 169 cobbled surface (see chapter 5) (fig. 3A). The stratification of section 26 shows the lateral transition between Tum. 1 and the cobbled surfaces. The cobbled surfaces alternate with colluvial deposits (Table 1). The furrows start from the top of the US 167 colluvium, affect the underlying US 169 cobbled surface and are covered by the US 163 cobbled surface. Ard-marks were clearly distinguished during the archaeological excavation in US 162, 163[3], 167 and 169[4], which cover the chronological period between the final phase of the Early Bronze Age (EBA II) and the Recent Bronze Age. In particular, on the top of US 169 cobbled surface, a single ploughing event has been exceptionally well preserved, while in US 123, 124A and 124B the ploughs interfered with each other, reworking the cobbled surfaces due to the low colluvial sedimentation rate.

Coarse anthropogenic components, such as charcoal fragments and potsherds, are sporadic and homogeneously dispersed in the profile.

In thin sections nos. 833, 834, 835 and 836 microscopic indicators of ploughing have been identified, although the interpretation of features may not be straightforward or unequivocal in colluvial materials (Deák *et al.* 2017; Mücher, van Steijn, Kwaad 2010). The recognised micromorphological features are comparable with those identified on modern cultivated soils (Jongerius 1970; 1983; FitzPatrick 1984) and in ard-tilling archaeological experiments (Gebhardt 1992; Lewis 2012).

Thin section no. 833, referring to the edge of a furrow, is characterised by compaction zones that are diversified in terms of arrangement and orientation of the coarse material (figg. 3B and 3C4). This structural modification of the soil is often associated with elongated voids parallel to the furrow cut (“echoid voids”) (Lewis 2012; Deák *et al.* 2017).

The upper sequence (thin sections nos. 834, 835 and 836) shows a medium-separated granular, vughy microstructure and thin dusty-clay coatings, also recognised in the furrow filling during ancient tillage experiments (Lewis 2012). Polyconcave vughs porosity prevails when soils are reworked by tilling activities and afterwards undergo compaction (Stoops *et al.* 2010a) (fig. 3C3). In cultivated soils these pores can be produced by soil tillage implements (Kutilek 2004).

Textural features, such as thin dusty-clay coatings, are common (fig. 3C2). The dusty-clay coatings are pedofeatures recognised in the voids and they derive from slaking processes, due to the impact of raindrops on the surface of the colluvial bare soil (Jongerius 1970; 1983; De Ploey, Mücher 1981; Macphail *et al.* 1990; Usai 2001). These pedofeatures can be found immediately below the ploughed horizons and are therefore called “agricutans” (Jongerius 1970; 1983, Macphail *et al.* 1990, Soil Survey Staff 2010), but they are also typical of colluvial context (Kuhn *et al.* 2010; Adderley *et al.* 2010; Mücher, van Steijn, Kwaad 2010). We also recognised finer textures surrounding rounded aggregates (Lewis 2012), such as “whole soil coatings” in “agric horizons” (FitzPatrick 1984) (fig. 3C1).

It is interesting to note that these coatings were not present in sample 833, which includes the lateral portion of the furrow fill.

## 5. The “MARS experimental area”

The aim of the project was to acquire more data about the ploughing process and the impact that it may have had on formation processes. The project took place over a period of five years, from June 2005 to August 2010, in an area specifically set aside for this purpose, named the “MARS experimental area”[5].

Using the conventional dimensional parameters applied in sedimentology (Ricci Lucchi 1980), each pebble was considered as a fabric unit: major (*a*) and intermediate axes (*b*), at right angles to each other, were defined for every pebble. The form of the pebbles was mainly spherical or disc-shaped (Folk 1968). Out of a sample of 1335 measured pebbles, the major axis (*a*) gave a mean

[3] AMS dating obtained on an animal bone sample coming from US 163 gave the following measurement: (KIA53597) 3067±19 BP, corresponding to 1406-1268 cal. BC (95.4%).

In this paper radiocarbon measurements expressed in BP have been calibrated to give calendar ages (BC) using the software OxCal 4.4.2 on the basis of atmospheric data provided by Reimer *et al.* 2020 (IntCal20).

[4] AMS dating obtained on an animal bone sample coming from US 169 gave the following measurement: (KIA53595) 3330±18 BP, corresponding to 1669-1532 cal. BC (95.4%).

[5] The projet was funded by the Autonomous Province of Trento.

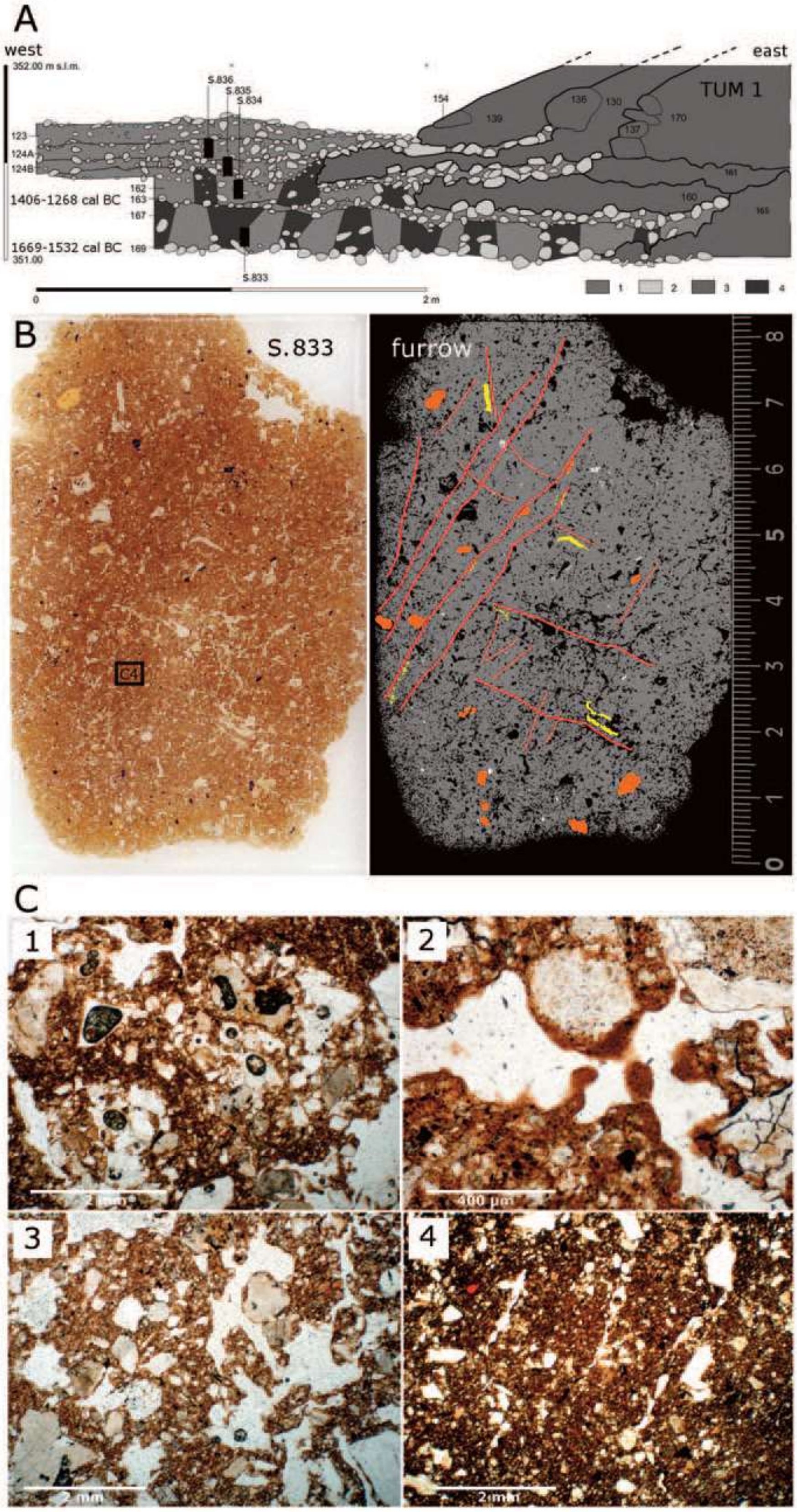



*Fig. 3. Gardolo di Mezzo (Trento). A. View of cross-section 26. 1. Colluvium. 2. Cobbled surface. 3. Tumulus. 4. Furrows. Black rectangle: positions of thin sections. B. Macrograph of thin section 833 and interpretation. Gray: groundmass. Red lines: compression zones. Yellow: elongated voids. White: charcoal. Orange: rock fragments. Rectangle indicate micrograph C4. C1. Micrograph from sample 836, "whole soil coating" (PPL, plane-polarised light). C2. Micrograph from sample 835, thin dusty soil coating (PPL). C3. Micrograph from sample 834, polyconcave vughs porosity (PPL). C4. Micrograph from sample 833, compaction zones diversified by arrangement and orientation of the coarse material associated to elongated voids parallel to the furrow cut ("echoid voids"; PPL).*

| US | Thin section (sample) | Soil horizon | Field description | Soil Micromorphology | |
|---|---|---|---|---|---|
| | | | | Description | Ploughing indicators |
| 123 | | 1Apb | sandy loam colluvium, dark brown 7,5YR 3/3-3/4, weakly medium granular, abundant subangular to subrounded cobbles (2-10 cm), common medium and fine pores. Abrupt linear boundary to: | / | |
| 124A | 836 | | cobbled surface, subangular to subrounded cobbles (2-5 cm). Abrupt linear boundary to: | close porphyric c/f related distribution | |
| | | 2Apb | sandy loam colluvium, dark brown 7,5YR 3/3-3/4, weakly medium granular, abundant subangular to subrounded cobbles (2-10 cm), common medium and fine pores. Abrupt linear boundary to: | **microstructure and porosity**: medium separated granular microstructure (top), vughy microstructure (bottom), compound packing voids, channel, chamber; **groundmass**: c/f$_{(7mm)}$, 40/60; **related distribution c/f**: open porphyric; **mineral**: sandy loam; **organic**: charcoal (250µm-2.5mm), microcharcoal (<50µm), amorphous organic fine material; **micromass**: crystallitic b-fabric; **pedofeatures**: non laminated thin dusty clay coatings, loose discontinuous infillings of channel by mineralo-organic excrements | elongated voids, agricutans, whole soil coating |
| 124B | 835 | | cobbled surface, subangular to subrounded cobbles (2-5 cm). Abrupt linear boundary to: | close porphyric c/f related distribution | |
| | | 3Apb | sandy loam colluvium, dark brown 7,5YR 3/3-3/4, weakly medium granular, subangular to subrounded cobbles (2-10 cm), common medium and fine pores. Abrupt linear boundary to: | **microstructure and porosity**: medium separated granular microstructure (top), vughy microstructure (bottom), compound packing voids, channel; **groundmass**: c/f$_{(2.3cm)}$, 30/60; **related distribution c/f**: open porphyric; **mineral**: sandy loam; **organic**: charcoal (250µm-1.5mm), microcharcoal (<50µm), amorphous organic fine material; **micromass**: crystallitic b-fabric; **pedofeatures**: non laminated thin dusty clay coatings, loose discontinuous infillings of channel by mineralo-organic excrements | elongated voids, agricutans, whole soil coating |
| 162 | 834 | | cobbled surface, subangular to subrounded cobbles (2-10 cm). Abrupt linear boundary to: | close porphyric c/f related distribution | |
| | | 4Apb | sandy loam colluvium, dark brown 7,5YR 3/4, massive (apedal), frequent subangular to subrounded cobbles (3-4 cm) and frequent centimeter calcareous granules, common medium and fine pores. Abrupt linear boundary to: | **microstructure and porosity**: vughy microstructure, channel; **groundmass**: c/f$_{(2.3cm)}$, 30/60; **related distribution c/f**: open porphyric; **mineral**: sandy loam; **organic**: charcoal (250µm-2.5 mm), microcharcoal (<50µm), amorphous organic fine material; **micromass**: crystallitic b-fabric; **pedofeatures**: non laminated thin dusty clay coatings, loose discontinuous infillings of channel by mineralo-organic excrements | elongated voids, agricutans, whole soil coating |
| 163 | | | cobbled surface, subangular to subrounded cobbles (2-10 cm). Abrupt linear boundary to: | close porphyric c/f related distribution | |
| 167 | 833 | 5Apb | loamy sand colluvium, dark brown-very dark brown 7,5YR 3/3-2,5/3, massive (apedal), few subangular to subrounded cobbles (5-8 cm) and frequent centimeter calcareous granules, common charcoal, few fine pores. Abrupt linear boundary to: | **edge of furrow:** **microstructure and porosity**: vughy microstructure, elongated void; **groundmass**: c/f$_{(50µm)}$, 20/80; **related distribution c/f**: open porphyric; **mineral**: sandy loam; **organic**: charcoal (100µm-1.50 mm); **micromass**: undifferentiated b-fabric; **pedofeatures**: loose discontinuous infillings of channel by mineralo-organic excrements | elongated voids, compression zones |
| 169 | | | cobbled surface, subangular to subrounded cobbles (4-10 cm), surface scored by ard marks. | close porphyric c/f related distribution | |

*Table 1. Gardolo di Mezzo (Trento), Garm 2. Brief stratigraphic field description and main soil micromorphology features of the colluvial sequence in section 26. Soil horizons have been described according to the FAO guidelines (2006). Symbols for soil horizons and soil classification follow the criteria of Soil Taxonomy (Soil Survey Staff 2010) and the "World reference base for soil Resources" (IUSS Working Group WRB 2015). Colours have been determined in the wet condition and are coded with the Munsell® Soil Color Charts (2000). The description and interpretation follow the criteria adopted by Stoops 2003, Stoops* et al. *2010, FitzPatrick 1984.*