PECULIAR HOLOCENE SOIL LAYERS: EVIDENCE OF POSSIBLE DISTAL EJECTA DEPOSITS IN THE CHIEMGAU REGION, SOUTHEAST GERMANY

76th Annual Meteoritical Society Meeting (2013)
5057.pdf

A. Neumair, Institute for Interdisciplinary Studies, Gilching, Germany (andreas.neumair@arcor.de)

K. Ernstson, Institute for Philosophy I, University of Würzburg, Germany (kernstson@ernstson.de)

Introduction

In the early phase of investigations in the northern part of the proposed Chiemgau meteorite impact strewn field in southeast Germany [1] the strong magnetic signature of smaller crater-like structures [2, 3] raised attention as did extensive soil magnetic susceptibility measurements in forests that revealed significantly enhanced values at some decimeter depth [4]. The authors exclude industrial and geologic delivery but avoid to discuss a third possibility. Such a possibility was later introduced when similar horizons with peak magnetic susceptibilities where found also in the southern part of the strewn field where they were associated with various peculiar components such as fractured pebbles, cindery glass and carbonaceous spherules [1]. Later, more small-sized craters with distinct magnetic anomalies were identified also in the southern part [5].

Fig. 1: Location map for the Chiemgau meteorite impact strewn field.

A second feature adds to the geophysical anomalies. In this region near Lake Chiemsee a peculiar feature has repeatedly been reported by the local population, especially in connection with channel digging, drainage work and house construction, that is a kind of a black "second soil layer" at a depth of at least several decimeters below the normal top soil.

Here we report on one of these locations at Eglsee near Lake Chiemsee where we have studied the content of the anomalous soil horizon of enhanced susceptibility with a focus on the glass and glass-like particles.

Geological Setting and Geophysical Signature

The area under discussion is predominantly composed of Pleistocene moraine sediments and gravels. Pebbles, cobbles and boulders up to the size of 20 cm are intermixed with sands and clays abundantly exposed in various gravel pits. The components represent Alpine material in the form of sedimentary rocks (mostly limestones and sandstones), magmatic rocks (mostly granitoids) and metamorphic rocks (mostly quartzites, gneisses, amphibolites, serpentinites and schists). Occasionally, larger blocks of cemented conglomerates (Nagelfluh) are observed. Locally, Holocene gravels, loess and loamy soils may contribute to the uppermost layers.

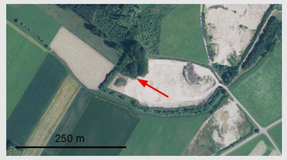

Fig. 2. Eglsee gravel pit (aerial photo Bay. Landesvermessungsamt). Arrow points to the exposed section.

At the Eglsee gravel pit (Fig. 2) the investigated section shows as follows (Fig. 3): The layer under discussion - we have been calling it the "black layer" - is intercalated in brownish terrestrial loamy sediments overlaying the fluvio-glacial deposits. The black layer of roughly 60 cm thickness (implying an upper and lower transition zone) is composed of few mostly angular clasts in a clayey to sandy matrix (Fig. 4). No farming and other human activities can be observed.

A soil magnetic susceptibility profile across the black layer (Fig. 5) shows significantly enhanced values.

Fig. 3: The black layer in a vertical section.

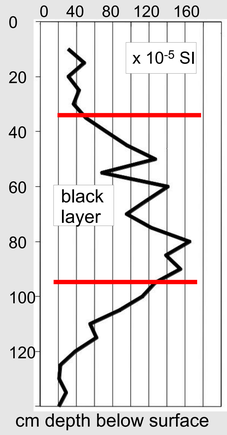

Fig. 5: Soil magnetic susceptibility.

Fig. 4: Close-up of the black layer in Fig. 3 showing clasts typically interspersed.

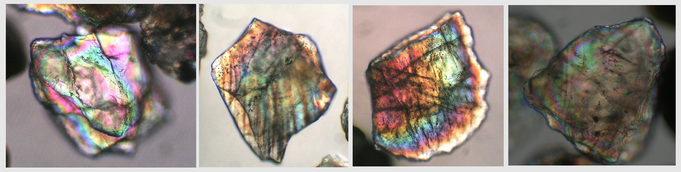

Fig. 6. Planar features in quartz grains from the black layer. Grain sizes between 250 and 350 µm.

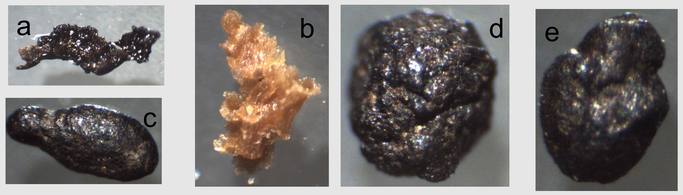

Fig. 7. Characteristic glass and glass-like particles from the black layer. a: translucent brownish (image width 2,5 mm) b: translucent yellow (1,8 mm). c: bottle-shaped (2 mm) d and e: humpy spheroids (2,5 and 1,8 mm).

Observations

Orientated towards the procedures described in [6] for unconsolidated materials, a sample taken from the the black layer was treated with break-up in water, ultrasonic cleaning, sieving and air drying. While the sieve fraction >2 mm proved to be a mixture of rounded to angular, partly sharp-edged rock fragments, the particles of the 1 - 2 mm fraction were mostly sharp-edged. All clasts were from metamorphic or quartz-rich rocks. Not any limestone or dolostone, generally making up a larger part of the country rock, was observed. For the 0.06 - 1 mm fraction binocular microscopic analyses revealed the quartz to increase proportionally with the sharp-edged partition. On grain slide under the polarizing microscope many quartz grains show multiple sets of planar features like planar fractures and deformation lamellae (Fig. 6). In a small portion of the 0,2 to 2 mm grain fraction we found very unusual features:

- translucent brownish-yellowish-pinkish and glossy black particles with irregular flaky and very fragile shapes (Fig. 7 a, b)
-- rock and/or mineral grains cemented with a transparent colorless probably glass material.
-- black iridescent particles with humpy spheroidal and teardrop or bottle-like shapes (Fig. 7, Fig. 8) some of them giving evidence of beginning melting. SEM imaging shows the interior to be a kind of a rubble pile composed of subrounded, angular, amoeboid and platy, micrometer-sized components (Fig. 8 c).

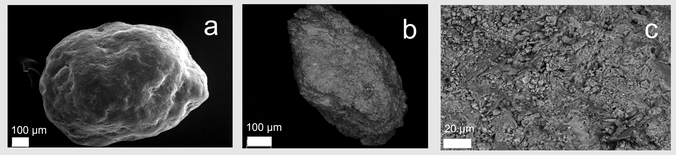

Fig. 8. SEM-images of black layer iridescent particles (a, b) and of the particles' "rubble pile" interior (c).

More evidence of unusual processes is given by the occurrence of particles with a distinct porous structure of siliceous material interpreted as to have originated from partial melting or/and complete decarbonization of silica limestone, a well-known facies of Alpine cobbles among the country rocks.

Discussion

The unusual composition and mixture excludes a common natural soil formation for the black layer. The dark color and the indication of melting processes in the first instance and with regard to the Holocene background suggest wildfires. However, no charcoal or other kind of burnt organic material was observed. The depth and lack of any human activity – including artifacts – point to an preindustrial age for the investigated horizon. Glassy material from Holocene explosive volcanism would require a transport over more than 750 km (Mount Vesuvius, Italy). Reworked material from former events can be excluded because of the presence of very fragile particles and the distance to pre-ice age sediments of more than 10 km. The relatively high amount of seemingly freshly crushed rock fragments and evidence of considerably enhanced temperatures speaks against simple weathering and soil formation.

Therefore,we point to some similarity of our black layer with layers of comparable facies known as "distal impact ejecta" [6, 7] and suggest also a relation to a meteorite impact event. We mention the glass and glass-like particles reminding of microtektites in distal ejecta layers that are mostly characterized as impact spherules representing target chemistry. Typical of distal ejecta layer are shock features [6, 7, 8] which we could not unambiguously establish so far, although the many quartz grains showing multiple sets of planar features could have been deformed by moderate shock. Moreover, the evidence of considerably enhanced temperatures can easily be explained by shock pressure release. Furthermore we must not forget the magnetic susceptibility anomaly the black layer is featuring, which corresponds with comparable anomalies over distal deposits at other locations (e.g., [9]).

Conclusions

From the obvious similarity of the black horizon with layers of comparable facies we suggest the Eglsee layer to be also of impact origin possibly as a distal ejecta layer having originated from one or more of the proposed craters in the Chiemgau impact event. Another confirmed impact event of spatio-temporal relationship is unknown [10].

References: [1] Ernstson K. et al. (2010) Journal of Siberian Federal University Engineering & Technologies 1, (2010 3): 72-103. [2] Rösler, W. et al. (2006) ESA First International Conference on Impact Cratering in the Solar System, Noordwijk, Netherlands. [3] Hoffmann, V. et al. (2004) Meteoritics & Planetary Science 40: A129. [4] Hoffmann, V. et al. (2004) Paneth- Kolloquium, Nördlingen, Germany. [5] Neumair, A., Ernstson, K. (2011) AGU Fall Meeting, San Francisco, U.S.A. GP11A-1023. [6] B.P. Glass, B.M. Simonson (2013) Distal Impact Ejecta Layers. [7] B.P. Glass & B.M. Simonson (2012) Elements 8:43-48. [8] G.R. Osinski & E Pierazzo (2013) Impact Cratering. [9] Abbott, D.H. Et al. (2011) AGU Fall Meeting, San Francisco, U.S.A. P33A-1753. [10] Earth Impact Database: http://www.passc.net/EarthImpactDatabase/