TEKTITE OR OBSIDIAN? – THE CASE OF THE CALI GLASS (COLOMBIA). L. Ferrière1, W. Wegner2, D. Topa1, D. Mader2, B. Gruber2, and C. Koeberl1,2, 1Natural History Museum, Burgring 7, A-1010 Vienna, Austria (ludovic.ferriere@univie.ac.at), 2Department of Lithospheric Research, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria.

Introduction: Tektites are distal impactites derived from the surface of the target rocks, with specific petrographic, chemical, and isotopic characteristics, as well as extremely low H2O content due to their mode of formation. They are a very rare type of impact glass found on Earth in only a few distinct strewn fields [e.g., 1]. Tektites along with some of the other types of impact glasses somewhat resemble obsidian and can be easily misidentified. Obsidian is a naturally occurring volcanic glass, generally black in color (as most known tektites) but it can also be brown, grey, or green. Obsidian typically exhibits layers, whereas tektites do not (with the exception of the Muong Nong-type layered tektites). Over the last 100 years, a number of glass samples were described as possible tektites and one of these glasses is the so-called “Cali glass”, which is found near the city of Cali (Colombia). This glass is assumed to be a type of obsidian by some authors, whereas others argued that it is a tektite [see e.g., 2, 3]. Recently, Ocampo et al. [4] have used the Cali glass, which they assume (without much evidence) to be a tektite, to, in turn, “confirm” the impact origin of a 36 x 26 km in diameter “crater” structure.

Here we report on a study of eleven Cali glass samples combining a number of different analytical methods to unravel the origin of this glass.

Methods: Two distinct sets of samples were investigated, including one set of seven samples from the Natural History Museum Vienna (NHMV) collection (i.e., these samples were given to the NHMV by a mineral dealer more than three decades ago; on the label it is written “Tektites, Cali, Colombia”), and four samples recently obtained from A. P. Crósta. Macroscopic investigations were conducted on all eleven samples. Six samples were cut (i.e., without any problem, which is interesting as tektites frequently explode during cutting due to internal residual stress) for the preparation of polished sections. Petrographic investigations were completed using an optical microscope and a JEOL JSM-6610 SEM at the NHMV. Major element compositions were measured for six samples at the NHMV using a JEOL JXA-8530-F field emission gun electron microprobe. Major and trace element abundances were obtained for three samples by instrumental neutron activation analysis (INAA) at the University of Vienna. Strontium and Nd isotopic compositions were obtained at the University of Vienna by thermal ionization mass spectrometry (TIMS).

Results: The investigated samples are dark brown to black in color, with sizes ranging from 2 to 5 cm (Fig. 1a). They are spheroidal, oval, or somewhat irregular in shape (with flattened portions), with heavily pitted surfaces. Some of the samples show some type of layering. In transmitted light, the glass is pale grey to pale brown in color. A few small vesicles and mineral inclusions occur, including quartz (and cristobalite?; would need to be confirmed using microRaman), feldspar, iron oxides, zircon, and apatite (Fig. 1b). One of the investigated samples shows alternating layers with numerous (preferentially aligned) microlites.

Fig. 1. Cali glass. a) Macrophotograph of a typical sample with pitted surface and remnants of soil. b) BSE image showing inclusions of quartz (Qtz) and feldspar (Fsp), and numerous microlites and tiny iron oxide inclusions in glass.
Microprobe investigations show that chemically, the glass is homogeneous in composition. The investigated samples show no major variations, neither at the scale of one sample (even not in the case of the layered sample), nor between different samples. This is also confirmed by the INAA data. Compositional ranges for major elements oxides (in wt%) as determined using microprobe for seven samples and for trace elements (in ppm) as determined with INAA for three samples are as following: SiO$_2$ (76.4-78.9), Al$_2$O$_3$ (12.2-12.9), TiO$_2$ (bdl.-0.19), FeO (0.35-0.59), MnO (bdl.-0.08), MgO (0.04-0.09), CaO (0.61-0.66), Na$_2$O (3.87-4.17), K$_2$O (4.64-5.00), Cr (5-8), Co (0.3-0.4), Ni (7-8), Rb (168-195), Sr (37.0-46.2), Zr (209-254), and Ba (300-367). As shown in Fig. 2, the K$_2$O + NaO content of the Cali glass samples is significantly higher than for tektites, but in the same range as for obsidians from Colombia and Ecuador as reported in [6]. The same is also true for other major and traces elements which abundances are very similar to those in obsidians from this region [see 6].

![Fig. 2. Total alkali vs. silica (TAS) diagram of [5] with Cali glass samples compared to typical obsidians [6] and tektites [7-9].](image)

Based on the three samples for which we have obtained Sr and Nd isotopic compositions, with high Nd isotopes (εNd values between 2.0 and 2.1) and low Sr isotopes (εSr values between 2.4 and 2.7), the investigated samples show a mantle signature, whereas all known “proper” tektites show a continental crust signature (Fig. 3).

**Conclusions:** Both the petrographic characteristics of the studied samples, such as the presence of layering and microlites, as well as the chemical composition, with extremely low FeO content and high K$_2$O + NaO content, and also the high Nd and low Sr isotopes values, typical for a mantle signature, suggest that the Cali glass is not a tektite but an obsidian. In addition, the report of frothing when heated [see 3] indicates that it has a high volatile content, also typical of obsidian but incompatible with tektite. Our investigations allow us to exclude an impact origin for the Cali glass, which are most probably volcanic in origin.

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