MIEN-RAMSÖ ISLAND IMPACT MELT ROCK AND BRECCIA: ORIGIN OF VESICULAR SHARP PEBBLES FROM THE RAMSÖ ISLAND.

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ABSTRACT
We studied vesicular, "rhyolitic" sharp pebbles from the Ramsö Island, Mien Lake, Blekinge County, Sweden. The Mien Crater has impact origin, the central peak is the Ramsö Island and impact melt rocks from Ramsö Island earlier were classified as rhyolites. In our samples we could see how impact melting transformed and preserved some parts of the original texture.

INTRODUCTION

At the beginning of XXth century the first two ring shaped geological structures identified as astroblemes (with exogenic impact origin) were: the Barringer Meteor Crater in Arizona, United States, and the Siljan ring shaped (lake and mountain) structure in Dalarna Region, Sweden. Till the end of the 80-es more than twenty candidates to astroblemic structures were found in Sweden [1] and more than thirty in North America [2] and about a hundred all over the world [2]. There are more then 10 very probable Swedish astrobleme structures. Mien Crater is the southernmost one, and can be found in Blekinge Region, about 30 km from the Baltic Sea shoreline.

HISTORICAL BACKGROUND

Mien Crater has got its name from the lake, Mien, which occupies a circular depression. This depression had been excavated into the Precambrian gneiss-granitic bedrock in the Cretaceous Period [1]. Holst [3] found (in 1890) boulders scattered around the lake, but mainly in the lake's northern vicinity. In his field and microscopy observations he supposed volcanic origin for these special rocks and he sent samples to Gy. Szádeczky (Hungary), and Zirkel (Germany) to study them. Gy. Szádeczky had earlier studied Hungarian rhyolites, especially from the Vlegyásza-Bihar Mountains [4]. Szádeczky found many similarities between Swedish and Hungarian rhyolites [5]. Holst [3] had also described them as rhyolites and that was the accepted classification of Mien-rhyolites till the work of Svensson and Wickman [6] who identified coesite (the shock-metamorphic variety of quartz) in the Mien-rhyolites, and so first they proved the impact origin of the Mien Crater [7]. Finally, test drillings proved, that the rhyolites, which were found earlier only as boulders (glacial deposits), could be found below a moraine layer (3-5 meters) and formed a 20-25 meters thick layer of bedrock of Ramsö Island, the central peak of the Mien Crater [7].

GEOMORPHOLOGY OF THE MIEN ASTROBLEME

The mountain ring which encircles the Mien Lake depression, has about 5 kilometers in diameter. It has a very special impact-geological characteristic: it has a central peak which emerges in the NW central part of the lake, as an island, the Ramsö Island.

The impact, which formed the Mien Crater, excavated the gneiss-granitic bedrock [1]. Crater formation models agree, that impact melt can be produced in the central depression. This impact melt forms a thin cover in the central region of the crater depression, and solidifies as volcanic rock and breccia. Central peak uplift had broken this impact-melt-cover and became the Ramsö Island. The northwestern shoreline of Ramsö is densely populated by "rhyolite" blocks. These broken blocks were transported and scattered as glacial deposits in the form of boulders on the northern and western shorelines of the lake [7].

DESCRIPTION OF THE SAMPLES

Macroscopic study The Mien Crater samples from Ramsö Island are mainly in the form of "sharp-pebbles", rounded by the water erosion. Their surface therefore, frequently exhibit a clear cut cross section of the rock, and so show the texture in naked-eye visible scale. This visible texture consists of light and light pink and yellow fragments and larger inclusions, sometimes granitic inclusions, and more or less vesiculas (bubbles) embedded into a lighter or darker gray mesostasis. Mesostasis seems to be homogeneous on this scale. Larger (two-three fist sized) specimens contain inclusions of some centimeter sized fragemnts, too. The western shoreline of Ramsö Island is populated almost exclusively with such samples.

Microscopic study Two samples were chosen for microscopic observations. Both samples show some kind of complexity which means that most of the samples can be identified as "impactite" with variolitic texture, but we could observe parts with higher proportion of glass and smaller potash feldspar crystals with intersertal texture and also some parts with brecciated texture. Brecciated parts contains several minaral fragments of the preimpact rock (Fig. 1.). The rock is rich in small unfilled vesicles, too.

Both samples contain potash feldspar, quartz, plagioclase, glass, opaque minerals (sometimes tiny grains of translucent ilmenite can be observed), rutile, hematite, limonite. Tiny biotite crystals were identified in the microprobe investigations, but in microscopic observations we could find only pseudomorphs after biotite and probably after amphibole. The pseudomorphs consist of brown, reddish brown, fine grained limonite, hematite.

Potash feldspar (sanidine?) laths or fibers mostly show radiant or divergent arrangement (Fig. 2.) which prove quite rapid cooling of the molten material in the variolitic parts. The intersertal parts are characterized with unoriented potash feldspars with polygonal interstices occupied by glass (with composition close to that of the potash feldspar according to reconnaissance microprobe analyses), microcrystalline quartz and ilmenite.

Quartz seems to be mostly a relict phase, it forms rounded polycrystalline aggregates with glass rim and clear indication of resorption on the edge of the aggregate. The composition of the glass rim is close to that of the potash feldspar (Fig. 2.). The boundary between the individual quartz grains in the aggregates is sutured. It seems from these textural features that the quartz aggregates suffered some kind of recrystallization. The aggregates of quartz are full of tiny opaque minerals, possibly ilmenite and with reddish hematite. New microcrystals of quartz crystallized from the melt can be found mainly in the intersertal parts, in the interstices of the potash feldspar associated with glass (potash feldspar glass) and ilmenite. Both quartz and potash feldspar are highly strained having undulating extinction.

Relict plagioclases of the preimpact rock are rarely observable in the parts having intersertal texture and in the brecciated parts.

The brecciated parts are bordered with plagioclase showing radiant arrangement and multiple twinning, glass and sometimes biotite. The breccias contain major strained quartz, plagioclase. microcline and accessory biotite, muscovite, amphibole, zoisite and zircon clasts in fine grained brownish groundmass.

SUMMARY, CONCLUSIONS

The Cretaceous impact which excavated the Mien Crater, had melted some parts of the gneiss-granitic bedrock. The high silica containing granitic composition of the bedrock implies that the impact melt was a rhyolithic one. (The impacting body could add only some few percents to the melt, but it could not change the character of the melt, which was determined by the bedrock chemistry, and the sediments stratified on it.).The Ramsö Island "rhyolite" samples are the rocks of the solidified melt.

How could this rock-unit become available on Ramsö Island? The impact melt covers the deepest central parts of the excavated depression. Solidification of this impact melt is a process of short time scale as compared to the long time scale (10000 years) of relaxing effects of stressed bedrocks below it. This relaxing effects couse the slow uplift of the stressed bedrocks in a form of a central peak "needle" of the crater. The central peak preserves its stratification during the uplift, therefore the "needle" of the central peak represents a kind of a "large drilling core" of the stratified materials, which had layered in the central depression during and after the impact event. Above this "needle", surface layers could be moved (eroded) away by glacial movements on that region (proved by moraines recognized). Underlain to this moraine layer the impact-melt-originated rhyolite layer lies, together with some breccias also of impact origin. Later erosion modified the broken fragments of this 20-25 meters thick layer, and this was the case in glacial period, when "sharp-pebble" shape of the broken rock samples was formed by eolic erosion. In conclusion: Ramsö Island (Mien Crater's central peak) fragments 1) are impact melts with vesicular structure, 2) have "sharp-pebble" shape by eolic erosion, 3) later were weakly rounded by the water erosion in the lake.

ACKNOWLEDGMENTS.
Discussions with F. Wickman, R. Stanfors and T. Szederkényi are highly appreciated and acknowledged.

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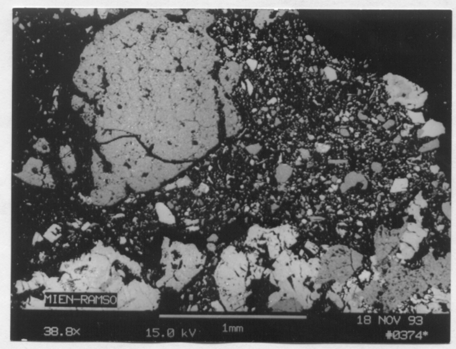
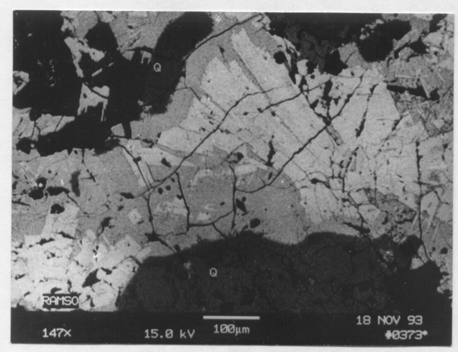


Photograph 1. A backscattered electron image of the brecciated part of the impact rock from the Ramsö island.



Photograph 2. A backscattered electron image of radial potash feldspars with glass rim towards the quartz (Q) aggregates.

Fig. 1. shows BSE image of a bracciated part of M-R sample. Fig. 2. shows BSE image of melted outer parts of a K-feldspar in contact with quartz glass (Q) region.