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Review paper

STUDY OF PHYSICAL-MECHANICAL ROCK PROPERTIES FOR ROCK DISINTEGRATION PURPOSES

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Abstract: New method of drilling narrow vertical boreholes by controlled hydrogen combustion assumes that rocks melt and around thermally strained rock form radial fractures under high temperatures and pressures at interaction of the rock and the flame. To verify the range of formed radial fractures in different rock types, it is needed to know in detail rock and mineral properties before and after melting process of the rock. Petrographical, mineralogical, chemical and physical properties of rock samples were studied to have thorough knowledge of rock attributes. Results of this complex rock analysis represent the basis for physical and mathematical modeling of viscous properties of melt of selected rocks and for modeling of radial fractures in the rocks during narrow vertical borehole drilling process.

Key words: rock properties, drilling, fracture, melt, penetration

1. INTRODUCTION

Looking for new ways of earth resources deposited relatively deep within the earth's crust, effective extraction of utility components from these deposits, safety and stability in tunnels after fire in them, or processing of large amounts of industrial waste – this are just some of the topics requiring deeper theoretical and practical knowledge of mineral, rock and rock massive behaviors under high pressure and temperature conditions.

The research is mainly focused on practical and theoretical verification of radial fracture origins within the rock massive at high pressure and temperature, and on the distance of resulting melt penetrating into these fractures (Lazar et al. 1998).

2. BEHAVIOR OF ROCKS IN A CASE OF THEIR DISINTEGRATION BY EXTREME TEMPERATURES AND PRESSURES

To verify the range of radial fracture origins and the range of resulting melt penetration during rock melting process at extremely high temperatures and pressures, it is necessary to know the rock properties before and after the process of their melt (Rybár et al. 2011). For this purpose, following rock types were studied: basalt,

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granite, andesite, sandstone and travertine. Each rock sample study includes microanalysis, chemical and geotechnical analyses. Proportionalities of mineral phases, their character and structure of the rocks were studied using optical microscope. Type of mineral growth, mineral zoning and mineral changes were studied via microprobe reflection. Presence of chemical elements and their oxides forming a substantial part of the rock was quantified by chemical analyses. Geotechnical analyses were accomplished on shaped rock samples. Results of these analyses describe physical and mechanical properties of studied rock samples (Table 1). Selected physical-mechanical rock properties were studied according to STN 72 1154 (bulk density, specific density, compactness) and ON 44 1115 (rock strengths). Research and study of high temperature and pressure impact on studied parameter changes are possible after such careful analysis of primary properties described above.

Table 1 - Geotechnical analysis of andesite from the Fintice quarry (average values from realized tests)

Sample	Bulk density [kg·m^{-3}]	Specific density [kg·m^{-3}]	Compactness	Plain pressure strenght [MPa]	Transverse pressure strenght [MPa]	Shear strenght [MPa]
andesite (Fintice quarry)	270.4	274.25	0.983	260.1	17.9	13.5

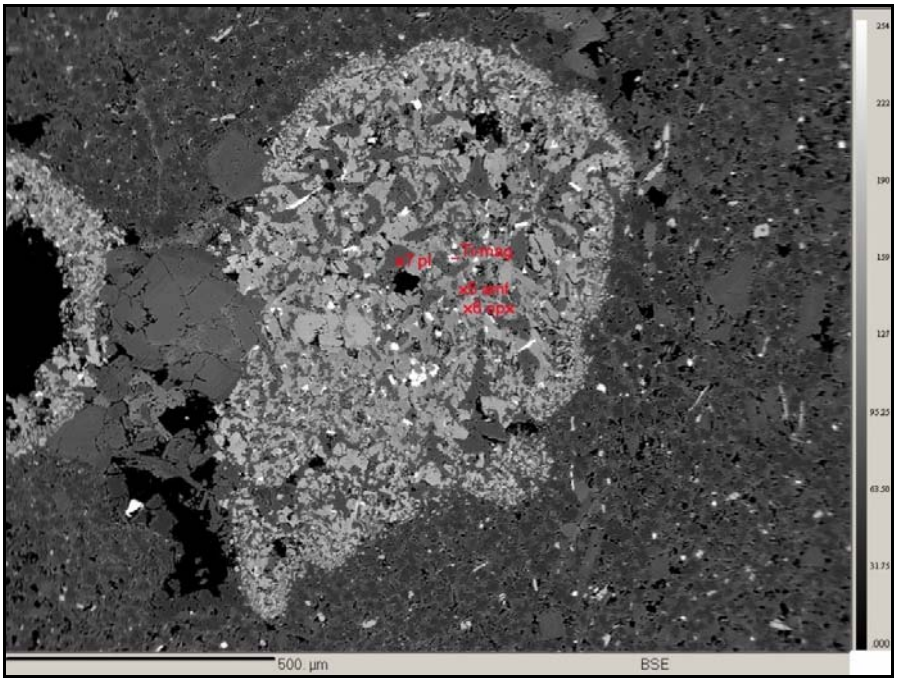

Figure 1 - Pyroxene disintegration on amphibole (amf), plagioclase (pl), zoisite and Ti-magnetite

Following text includes an example of studied rock sample – amphibole-pyroxene andesite from the Fintice quarry. The rock is light grey with aphanitic to porphyric texture with felsic matrix. Mineral composition of the rock is: 30 – 40% matrix with phenocrysts of amphibole, orthopyroxene and plagioclase. Matrix also contains fine grained quartz, plagioclase and feldspar, orthopyroxene and Ti-magnetite.

Hypdiomorphic lamelled to twinned white-grey plagioclase phenocrysts, locally forming grainy aggregates, dominate in the matrix. Its composition is similar to anorthite to labradorite. It change is partially visible – sericization – mainly in the cracks. Some phenocrysts have very fine oscillatory growth zoning. Ca-Mg-Fe pyroxenes occur in form of hypidiomorphic light phenocrysts of diopside to augite composition. They are pretty altered, partly changed into Mg-hastingsite (amphibole). Allotriomoprhic amphibole is pressed by opacite lamellas. Pleochroic biotite is rarely visible. Relatively big opaque minerals (Ti-magnetite and ilmenite) are sporadically visible. In general, studied andesite sample is a volcanic rock originated as a consequence of subduction processes within the earth's crust (Rybár et al. 2011). Geotechnical properties of studies sample are summarized in the table 1.

3. CONCLUSION

The research itself and its results follow previous research of the LITHO-JET technology (Lazar et al. 1998; Rybár et al. 2004). Research within the project "New detection methods and technologies for exploitation of unconventional energetic Earth resources" is an important knowledge supplement of rock disintegration at high pressures and temperatures. It also brings new information about properties of studied rock samples used in this phase of the project.

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