

Rock Fragmentation by High-Voltage Pulses: Review of Observations and Objectives for the Research

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Abstract—The research on the rock-breaking mechanism by electrical discharge began at Tomsk University in the 1960s. Through experiments, Andres (1995) [1] proposed the dependence of the electric breakdown field strength of water, rocks, and oil on the pulse rising time. With a rising time shorter than 500 nanoseconds, the discharge plasma occurs mainly in a sandstone. Otherwise, the discharge occurs in the fluid surrounding it. For a quartzite, this limit is around 200ns, and we know that air is always more conductive than rocks and water. On the ground, after a thunderstorm, especially in deserts of sand, we observe tubes of melted pure silica (Figure 1) composed of Lechatelierite mineral [2]. At the laboratory scale, on rocks, a channel crossing the sample is created. Due to the stress caused by the expansion of the plasma channel, the rock can be fragmented (Figure 2). Several experiments performed to optimize pulse voltage, electrode gap, and the number of pulses will be presented and discussed in the function of the intended applications: drilling hard rocks or rock comminution.



Figure 1 Fulgurites from Columbia USA (length~100 mm) and section of Fulgurite from Germany (diameter~15 mm)
School of Mines Mineralogy Museum



Figure 2 Impact of 1 pulse on saturated (10_1) and dry (10_4) Sandstone sample (Diameter 65mm, Height 10mm)
Max voltage of pulse 90 kV, electric field 9kV/mm
SELFRAG bench at BRGM

Références

- [1] U. Andres, *Electrical Disintegration of Rock*. Mineral Processing and Extractive Metallurgy Review, An International Journal, 14:2, 87-110. (1995)
- [2] M.A. Pasek, K. Block, V. Pasek, *Fulgurite morphology: a classification scheme and clues to formation*. Contrib Mineral petrol, 164:477-492. (2012)