ON EXPERIMENTALLY AND NATURALLY PRODUCED SHOCK EFFECTS IN ROCK FORMING MINERALS.
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Introduction: Hypervelocity impacts of dust- to kilometer-sized projectiles (i.e., planetary bodies and human-made probes) are part of the background processes in space that has left their marks on every solid object in space. Impacts on asteroids, Mars and the Moon have been capable to eject rock fragments into space; some of these ejecta may eventually arrive on Earth and be recovered as meteorites [1]. Almost all meteorites were subjected to shock events caused by hypervelocity collisions [2], and their shock pressure and temperature conditions can affect the geophysical [3], mineralogical [4] and geochemical [5-6] properties. Characterizing the degree of shock metamorphism in planetary materials is essential to interpret isolate measurements related to age determination [5-8], the possibility for life to survive such conditions [9] and the magnetic properties [3,10].

The thermal disturbance of radiometric ages can be advantageous, as different isotopic systems are more or less susceptible to shock resetting [6,8,11]. This is of relevant for interpreting the ancient lunar impact record [11] and the controversy regarding the ages of shergottites (type of martian basaltic meteorites). Currently, shergottites are proposed to be either old (>4 Ga) samples of the Noachian crust and derived from the ~60 km sized Martian crater “Mojave” [12-15], or young (<600 Ma) late Amazonian lithologies ejected by different impact events from various regions on Mars [1,7,8,16]. The different interpretations have strong ramifications for the geological record provided by the only available samples from Mars.

On current controversies: We will 1) review some basic principles of shock metamorphism, 2) compare high pressure experiments with different pressure duration and initial temperature and 3) compare the deduced shock pressure and temperature conditions in shocked meteorites with other properties of the rock that can be affected such as petrology and the noble gases content.

Conclusion: Shock effects in different rock forming minerals and their mineral-type chemical composition range include brittle deformation such as planar deformation features (PDF), undulatory extinction and mosaic in olivine and pyroxene and ductile deformation such as formation of diaplectic glasses. These diagnostic features serve as a shock pressure barometer allowing the calculation of shock temperatures in non-porous igneous rocks consistent with a variety of independent properties. These diagnostic shock features should be used for shock classification.