PRODUCTION OF IMPACT-DERIVED FELSIC MELTS WITHIN EARTH'S EARLIEST CRUST: THE ROLE OF INCONGRUENT MELTING OF HYDROUS MINERALS

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RESUMO: Combined results of lunar and terrestrial crater counts and estimates of asteroid flux suggest that the primordial composition of the Earth's earliest crust was severely modified during the post-accretionary bombardment between 4.5 and 3.9 Ga. The connection between meteorite impacts and Earth's crustal differentiation has been, however, poorly explored given the notion that impact melting is a relatively shallow crustal process and that the impact melt sheets have the average composition of the target rocks. Evidence from crystalline rocks of the 40 km-wide Araguainha impact structure (central Brazil) indicates that not only the surface rocks, but deeper levels of the crust can experience substantial geochemical remobilisation immediately after the meteorite collision. Shock-induced, incongruent melting of individual grains of biotite (at estimated shock pressures of 20-25 GPa) generated alkali-rich melts that are demonstrably more felsic than the precursor mineral. Our observations in conjunction with results of previous studies indicate that important hydrous minerals (common in oceanic and continental crust) can undergo incongruent shock melting, producing highly mobile, felsic melts that accumulated as melt pockets or were injected into fracture networks of the target crust. The relatively low shock pressures required for breakdown of hydrous minerals (20-30 GPa) imply that impacts the size of Araguainha or larger are capable of generating substantial volumes of incongruent melt within Earth's crust, depending on the availability of hydrous minerals. Given widespread evidence of continuous recycling of water-saturated continental/oceanic rocks between 4.4 and 4.0 Ga, we suggest that impact-induced breakdown of hydrous minerals was an important mechanism of crustal differentiation and chemical reorganisation of the Hadean crust.

PALAVRAS-CHAVE: METEORITE IMPACTS; BREAKDOWN OF BIOTITE.