IMPACT MELT GENERATION AT METEOR CRATER, ARIZONA: IMPLICATIONS FOR IMPACTS INTO VOLATILE-RICH TARGET ROCKS.

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Introduction: Impact melting is one of the most characteristic features of meteorite impact events. It is known that target lithology, in particular the effect of volatiles, plays an important role in determining the amount of melt generated and the characteristics of impact melt-bearing impactites. Here, we present the results of our ongoing investigations of the generation of impact melts at Meteor Crater, Arizona.

Impact melts at Meteor Crater: Meteor Crater was formed ~50 ka by the impact of a ~40 m diameter iron projectile into a target sequence of interbedded dolomite and sandstone, with subordinate limestone and siltstone [1]. Recent studies have yielded important information about the generation of impact melt at Meteor Crater. Hörz et al. [2] provided the first detailed study of the ballistically dispersed melt particles and placed constraints on the stratigraphic extent of the melt zone. Melosh and Collins [3] suggested that Meteor Crater formed by a low-velocity impact event. Our studies have documented the presence of carbonate-derived melts [4] and impact melt-bearing breccias [5] at Meteor Crater for the first time.

Results: Here, we show that that siliceous dolomite, limestone, and carbonate-bearing sandstones underwent shock melting during the formation of Meteor Crater. The initial product was a SiO_2-poor, CaO–MgO–CO_2-rich dolomitic melt that crystallized Ca-rich clinopyroxene, Mg-rich olivine, Mg-rich orthopyroxene, calcite, and minor dolomite. The residual melt quenched to a glass with exceptional CO_2 contents (up to 40 wt%). Spherules of calcite and the skeletal habit of the silicate crystallites attest to rapid quenching of the melt.

Discussion and Conclusions: We have shown that carbonates underwent melting at Meteor Crater, in addition to other sedimentary lithologies as previously noted [6]. This work adds to a growing body of evidence showing that impact melting is common during impacts into volatile-rich targets (see [6] for a review). Questions still remain, however, such as why silicate phases derived from the melting of sedimentary rocks are common at Meteor Crater, when at larger craters (e.g., Ries and Haughton), carbonate melt phases predominate.

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