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Numerical modeling of meteorite impact crater formation and shock wave propagation in porous sandstone

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The objective of this work is to investigate meteorite impact processes related to the shock-induced compaction of pore space and the subsequent release of shock pressure in porous sandstone by numerical modeling on the macro- and mesoscale using the hydrocode iSALE. We compare models against data obtained in the framework of the MEMIN laboratory impact experiments. Detailed analyses of pore closure using mesoscale modeling indicate a localized amplification of shock pressure of up to four times the initial pressure during shock wave propagation in heterogeneous materials. This is in good agreement with observed localized shock effects in experiments on dry sandstone. Crater morphology and porosity distribution underneath the crater are in good agreement with the experiments. The model is capable to describe an increase of porosity as a response to unloading of shock corresponding well to the experimental observations where porosity is increased beneath the crater floor due to the formation of tensile cracks parallel to the crater floor.

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