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Bedding-parallel lenticular dolomite bodies in the St. Louis limestones (eastern Kentucky, U.S.A.): Seismogenic sediment-deformation structures in an extensional setting

Min Zeng (1) and Frank Ettensohn (2)

(1) College of Earth Sciences, Chengdu University of Technology, Chengdu, China (zengmin.inter@gmail.com), (2) Department of Earth and Environmental Sciences, University of Kentucky, Lexington KY, USA

Peculiar bedding-parallel lenticular dolomite bodies, tens of centimeters thick with dramatically varied length (30cm∼50m) and with an exposed area of over 3000km2, occur exclusively in the St. Louis Member limestones in eastern Kentucky, USA. In this study, detailed field descriptions, by investigating 44 sections, reveal key features of the dolomite bodies and shed light on their formative processes. The dolomite bodies are closely related to various types of sediment-deformation structures, suggesting they are also of sediment-deformation origin and, moreover, deformation features and spatial distribution of deformation intensity indicate a seismogenic origin. During the seismically-induced deformation, the dolomite bodies behaved rigidly and competently, in contrast to the muddy sediments that were fluidized and less-competent; combing the fact that the hosting strata were mostly undisturbed, it implies that, rather than being emplaced from anywhere else, the lenticular dolomitic structures were generated out of the St. Louis limestones in situ during the deformation and selectively dolomitized afterwards. Overall deformation features of the bedding-parallel lenticular structures are comparable to the boudinage structure of “hard” rock deformation, which suggests the lenticular structures, as the precursors of the present dolomite bodies, were formed as the competent boudin-like structures during the earthquake under extensional stress regime. Furthermore, it is proposed that the fracture porosities, such as the syneresis cracks and interior fractures formed during the deformation, created much higher permeability to the precursor lenticular structures than the hosting strata, which favored the circulation of Mg-rich fluid in the former, and was responsible for the later selective dolomitization. The understanding is of significance for future studies on other bedding-parallel lenticular structures, which could be as important as the ball-and-pillow type deformation in geological history.