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CASRock—a code to simulate THMC processes in fractured geological media

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This work presents the advancement of a self-developed Cellular Automata Software for engineering Rockmass fracturing processes (CASRock, <http://en.casrock.cn/>) in the applications of thermo-hydro-mechanical-chemical (THMC) processes in fractured geological media. It contains a series of previous developed numerical systems, namely EPCA for simulation of heterogeneous rock failure process, VEPCA for visco elastoplastic analysis, D-EPCA for rock dynamic response simulation, THMC-EPCA for coupled THMC processes in geological media and RDCA for simulation of rock cracking process from continuity to discontinuity. In CASRock, the non-isothermal, unsaturated fluid flow, mechanical process and chemical reaction are sequentially coupled by updating all the state variables using cellular automaton technique and finite difference method on spatial and temporal scale, respectively. The Lagrangian method is used to simulate the particle transport. The control equations, coupling scheme and numerical implementation are briefly introduced. Several applications, including in the background of high level nuclear waste disposal are provided to show the abilities of CASRock in the simulation of coupling processes between physical fields. These applications include, (1) stability analysis of engineering rockmass under mechanical loading, (2) numerical study on coupled TM processes in hard rock pillar, (3) study on coupled THM processes in engineering barrier, (4) simulation of the THMC process in fractured rock.