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Hexagon CNN and its applications in sphalerite banding texture simulation

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Banding textures are widely found in mineral crystals as has been observed in Mississippi Valley-type sphalerite. Cellular Nonlinear Network (CNN) has been developed as a paradigm for exploring complexity especially for reaction-diffusion dynamic systems. Based on reaction-diffusion processes a 1-D model has been proposed in the literature for describing periodic precipitation incorporating nucleation and a 2-D model for modeling banding pattern formation in minerals by means of coarsening waves for describing Mississippi Valley-type sphalerite. Our research indicates that the reaction-diffusion process some times occur as form of hexagon inward or outward during mineralization. Based on this observation, a CNN model was developed according to a hexagonal lattices partition to simulate the process for the forming of sphalerite. This model divides the hexagon space into triangular cells and defines the coupling law according to the hexagon lattices. The model was implemented with initial conditions used in th literature and the results show that the mole fraction of FeS in solid phase correlates with the observed band color, forms banding textures and that the radii of the sphalerite crystal oscillating decrease from outside inward. The simulated results are in agreement with some observations which imply that the CNN model introduced in this paper is reasonable and could be used to interpret the mechanism for the forming of various textures of sphalerite and probably of other minerals.