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Inter-array and intra-array kinematics of en échelon sigmoidal veins in cross-bedded sandstone, Merimbula, southeastern Australia: Discussion

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In his paper on sigmoidal veins in sandstone Smith (1999) distinguishes two models of the formation of arrays of échelon veins.

1. In the second model, his bridge-rotation model, he ascribes opening to the bending of the strips of rock separating veins from one another (bridges), comparing the kinematics of the process with kink-formation, regarding it as analogous to the development of saddle-reef vein systems in fold hinges. Bridges are defined by an already existing planar anisotropy (bedding for example), shortened as veins open. With the anisotropy common to both, transfer to bridge-material between host rock and array is implied. Veins may develop walls of different primary lengths.
2. In defining this second model Smith refers, however, as if in confirmation of its characteristics, to accounts in which the context envisaged for vein formation is quite different (Nicholson and Ejifor, 1987; Nicholson, 1991). In them, and a third on which they rely (Nicholson and Pollard, 1985), the planar surfaces defining bridges (fractures in this instance) arise as part of the vein-forming process and are limited to the array. Transfer of bridge-materials is prohibited. Veins must have walls of the same primary length. Bridges are pulled apart as fractures open, bridge-bending (folding) reflecting attachment to the walls of the array, not shortening across it. Moreover, rupture follows as opening proceeds, not continuing bridge-rotation.
3. The contradiction inherent in attempting to combine two essentially different models is evident in fig. 7. Here an array of échelon veins is shown fitting the requirements of the model put forward by Nicholson and Pollard (1985) in so far as bridge-defining surfaces are limited to the array. Transfer of material from host rock to array is thus not possible. However, the so-called asymmetric vein it contains (third vein from the right) has walls of different primary length (the bridges on either side have retained their initial orthogonal thicknesses). Addition of material to the array is required for it to open, removal for the restoration through closure of the rectilinear surface from which it formed.
4. The attempt to combine elements of a model involving shortening over a developing vein array which shares its basic structure with the country rock, with a second requiring extension, and in which no such sharing takes place, is not successful.

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