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# Self-affinities for Amplitude and Wavelength of Folds

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In general, many folds are apparently curved or jagged on a wide range of scales, so that their geometries appear to be similar when viewed at different magnifications. By Matsushita and Ouchi (1989a, b)'s method, we also analyzed the self-affinities of folds in the North Honshu Arc, Japan (Kikuchi et al., 2013). Based on this analysis, geometries were found to be self-affine and can be differently scaled in different directions. We recognize the self-affinities for the amplitude and the wavelength of folds and a crossover from local to global altitude (vertical) variation of the geometries of folds in the Northeast Honshu Arc.

Buckingham's Pi-theorem is sufficient to the first problems of fold systems (Shimamoto, 1974). However, the complete similarity cannot give us the self-affinities of folds. A general renormalization-group argument is proposed to the applicability of the incomplete self-similarity theory (Barenblatt, 1979). Based on the general renormalization-group argument, we derive the self-affinities for the wavelength ($L$) and the amplitude ($a$) of folds:

$$L^{(1-d)} \propto a.$$

The relationship between Hurst exponents $H$ of fold (Kikuchi et al., 2013) and $d$ are equation:

$$1\text{-}d=H,$$

where $H$ is index of the continuity of a given fold curve and obtained by the ratio between horizontal scaling exponent and vertical scaling exponent. $d$ is an exponent of a given incomplete self-similarity theorem.

In $d \neq 0$ case, the Hurst exponent $H \neq 1$ indicates self-affinities for the given fold curve. In this case, scale invariance of the fold might be affected by a variety of tectonic processes under the anisotropic stress field. In $d = 0$ particular case, the Hurst exponent $H = 1$ indicates self-similarity for the given fold curve. In this case, scale invariance of the fold might not be affected by a variety of tectonic processes under the anisotropic stress field. These results imply that anisotropic stress fields by gravitation and tectonic stresses might cause self-affinities of folds. Self-similarity and self-affinities of the fold might be affected and by a variety of tectonic processes under the isotropy or anisotropic stress field.

Reference

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