Optimisation of representative elementary area (REA) for the preparation of lineament density map of fractured rock aquifer

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Abstract

The lineament density map derived from remote sensing data of the fractured rock terrain plays an important role in the evaluation of the groundwater resource in the associated fractured aquifer. Application of the lineament density map frequently encounters the problems of whether the density map is representative of an area and whether the map can be effectively applied at a regional scale. Lineament data captured from Landsat ETM^+ imagery in 7 domain areas in the Table Mountain Group (TMG) sandstone terrain were used to compute and analyse lineament densities. Methods of determining representative elementary area (REA) on a domain-area scale and on a study-area scale were developed, respectively, based on the power law relationship of lineament densities with computing cell sizes, linear relationship of REAs with domain-area sizes, and the power law relationship of REA percentages with domain-area sizes. Using the function convergence criterion of curve slope less than 1º and measuring dimension in units of area (L^2) other than units of length (L), the REA of each domain area can be accurately determined. REA scale-effect analysis helps to optimise the determination of REA in a study area, and the optimisation of REAs may in turn improve the lineament density map generated for regional groundwater studies.

Keywords: lineament density, representative elementary area (REA), fractured rock aquifer, Table Mountain Group (TMG)