Trial of domain segmentation of granite based on fracture orientations using Dip Azimuth Vector plot

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In geological disposal of radioactive waste, it is important to develop a method to extract as much information as possible from one borehole. Here we show the results of a trial of domain segmentation of granite using the Dip Azimuth Vector plot, which is often used in resource exploration drilling, according to the dominant fracture direction in each part observed by BHTV. The term "domain segmentation" means that, for example, a fracture dominant region having a NE-oriented strike and a high-angle NW dip is distributed 50 m in borehole length, and a deeper section is distributed in a section in another direction. In crystalline rocks such as granite, cracks are the main flow path of groundwater. Improving the method of quickly grasping the fracture dominant direction and the intersection of fracture systems at domain boundaries will contribute to the refinement of groundwater flow models.

The data used was strike and dip of about 800 fractures obtained from a 240m borehole TV image taken at the MBC-2 hole drilled on the site of the Japan Atomic Energy Agency's prototype fast breeder reactor Monju. The Dip Azimuth Vector plot (also called the Walkout plot) accumulates the sine and cosine of each data from the dip direction (360-degree dip direction), the cumulative sine on the vertical axis and the cumulative cosine on the horizontal axis on the Cartesian coordinates. This is a method of observing the trend and its change by the dip direction of planer structures, and is used to divide the geological structure in the borehole direction (eg Ciupercă et al., 2018). Here, the origin is the ground surface, and the depth at which the trend is bent, that is, the domain boundary (m; rounded off to the decimal point) and domains A to L are shown (Fig. 1). They have the following characteristics:

Domain A (section length 75m, the same applies hereafter)-Slope direction SSW trend (the same applies below) showing large variations. Domain B (37m)-Small variation in SE trend. Domain C (12m) -NE trend showing small variations. Domain D (18m) -SE trend showing small variations, and the trend matches the domain B. Domain E (11m) -SSW trend showing large variations. Domain F (9m) –WNW trend showing small variations. Domain G (37m) - SE trend, same as B and D, showing small variations. Domain H (11m) -E trend showing small variations. Domain I (4m) -WNW trend, same as F, showing small variations. Domain J (13m) -ESE trend showing small variations. Domain K (2m) -NNW trend showing small variations. Domain L (10m) -ESE trend, same as J, showing small variations. The median of the section length excluding the domain A and L is 11.5 m, and the average value is about 15 m. The average dip of the fracture is about 47 degrees since the cumulative dip angle is 37226 degrees with respect to the number of fractures of 794, and the variation in each domain is small. Domains B, C and D, for example, have the strike and dip of, B and D; N29E47E, C; N45W47E. Intersection lines of the domain boundaries, i.e., intersection of the two dominant fracture orientations, dips 41 degrees into 82 degrees of azimuth, as a possible pipe-like flow path of groundwater.
We present some results of domain division analyses using a few neighboring boring hole data.

