Fracture analysis determined from integrated analysis of core-description and BTV images: Example from Cretaceous Toki Granite

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The Japan Atomic Energy Agency (JAEA) has been carrying out a wide range of geoscientific research in the Tono area of central Japan in order to build a firm scientific and technological basis for the safe geological disposal of radioactive wastes. During the course of this project more than ten boreholes about 1,000 m deep have been drilled to investigate the Late Cretaceous Toki Granite. The Toki granite is composed mainly of fine- to coarse-grained biotite granite about 12 x 14 km area. In the study area, the Toki Granite is partly covered by Miocene and Pliocene sedimentary formations. The Toki granite and the Miocene formation are cut by the two major faults in the area: the reverse Tsukiyoshi fault trending E-W steeply dipping to the south, and the vertical NNW-SSE trending Shizuki fault. The Pliocene formations postdate these fault activitiess.

The present paper focuses on characterizing the fracture system in the Toki Granite from the surface to a depth of 1,000 m. The information and data were provided by JAEA consisting of detailed core description and the Borehole TV (BTV) images from boreholes DH-8 and DH-9. Borehole DH-8 (1,010.20m deep) is located near the western margin of the granite body, whereas DH-9 (1,030.75 m deep) is located near the center.

BTV images were used for comparison and matching of fracture data obtained from the detailed and, non-oriented, core description. Fracture statistics, such as orientation and density distribution were obtained from the BTV images, while the core logs provided detailed morphological and mineralogical information. Using the integrated data, the relationship between the orientations, morphological types, and in-filling minerals was analyzed. According to the characteristics of their attitudes and types, the fractures are classified in two groups: (i) fractures with planar surfaces predominantly dipping sub-vertically and trending EW, NW-SE and NE-SW and (ii) predominantly sub-horizontal fractures with irregular surfaces. Analysis of the fracture infilling material shows the frequent presence of clay minerals, dominated by chlorite and smectite, in the sub-vertical fracture set. The variations in fracture attitude with depth along the boreholes are also studied. The origin of the fractures and their probable links to the main geological structures and to the geological development in the area are discussed in the paper. The study of fractures presented in this paper provides important data for the development of representative geological and groundwater flow models in fractured granitic rock.