

Reconstruction of paleostress state associated with fossil fluid flow based on residual stress data

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Fractures play an important role as a conduit for fluid and major fluid movement in upper crust is achieved with the help of discontinuity such as fractures and faults. As characteristics of regional fracture system is likely to be constrained by regional tectonic stress field and fracture width is controlled by local stress acting to the fracture in conjunction with arrangement of the fracture orientation to the regional stress, knowledge on the stress field is one of important issues to understand regional fluid movement.

Field observations on natural fracture system and petrologic studies on veins will provide information on potential fluid flow pathway, orientation of principal axes of the stress field at the fracture formation and chemical composition of fossil fluids. However, it is often difficult to estimate absolute stress magnitude which is responsible to the fluid flow.

Angelier (1989) proposed a method to evaluate absolute stress magnitude of paleostress based on fault slip data. Here, we propose new approach for evaluating absolute stress magnitude by means of residual stress investigation on vein mineral.

Residual stress is internal stress in materials to which no external force is acting. In case of rocks, residual stress formation is mainly caused by previous tectonic activity. Stress relaxation operation by overcoring demonstrates formation of such residual stress in rocks and potential mechanism for the residual stress formation for various tectonic activities has been investigated.

In case of residual stress formation in a vein, the layered geometry of the vein and its host rock having different physical properties proposes a unique mechanical configuration to understand residual stress formation in response to paleostress field. Because of its simple geometrical configuration of the two materials, we can attribute the residual stress formation in the vein to pressure - temperature change during regional exhumation.

Residual stress starts to be stored in the form of elastic energy, when the fossil fluid was sufficiently solidified. Thus paleostress reconstructed by the residual stress represents the stress responsible for the fossil fluid flow in the fracture.

X-ray diffraction method was tested for residual stress examination on a quartz vein. Based on the data, we will report an attempt to reconstruct the paleostress associated with fossil fluid flow in this presentation.