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Integration of Three-Dimensional Petroleum Migration Model, Geomechanical Model and Source Rock Depositional Model: Challenge for the Development of Full Petroleum System Model

Basin modeling technique was started in 70's as zero-dimensional source rock maturity model, and has evolved to one-dimensional model introducing compaction, heat transfer and kinetic model and to two-dimensional model with fluid flow. Even three-dimensional petroleum migration model has been developed in late 90's and started using in actual exploration and production projects in oil companies.

However, present three-dimensional petroleum migration model is not perfect and lacking enough capability to model essential phenomena in petroleum system such as petroleum migration through faults and fractures, and source rock development. Our solution is to develop additional computer models to simulate these phenomena and establish the linkage among these models.

In order to model petroleum migration through faults and fractures, we have developed forward geomechanical model which calculates stress-strain condition and plastic-elastic deformation. We adapted cam-clay model developed in civil engineering. Our test indicated that this model can simulate work-softening (fault leak) and work-hardening (fault seal) effects.

In order to model source rock development, we have developed source rock depositional model which calculate water circulation, organic matter production and preservation. Our case study in present Lake Tanganyika that this model can simulate observed water circulation and organic matter production and preservation.

These new two model will be combined with our three-dimensional petroleum migration model and case studies in actual geological basin will be conducted soon.