Hydrothermally Dissolved Dolerite Reservoir in the Akita Basin, Japan

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Altered sheeted dolerite dykes form important oil reservoirs in the Ayukawa oil field. Secondary porosities are created in dolerite by dissolution of pyroxene and plagioclase. The Ayukawa oil field is located in the Akita basin, a back-arc basin in northern Japan. The Onnagawa formation is mainly composed of Neogene siliceous rock, and is the major source rock of the area. Dolerite sheets intrude into the Onnagawa formation, and form stratigraphic traps.

Dolerite in the area is classified into three types. Type I Fresh Dolerite: fresh pyroxene remains, Φ0-3%. Type II Altered Dolerite: most pyroxenes are altered to clay minerals such as saponite and talc. Φ5-8%. Type III Dissolved White Dolerite: mafic minerals and some plagioclase are dissolved to create secondary porosity. Φ15-25%. One dolerite sheet is about 100m thick. The top 40m and the bottom 15m are mainly Type III highly altered dolerite, and produce oil. The middle part is Type II or Type I, and non reservoir.

The Akita basin was initiated by opening of the Sea of Japan. Petrographic analyses suggest the following model. Rift related submarine volcanic activity continued till the Middle Miocene Onnagawa stage. Dolerite intruded into the Onnagawa diatomaceous siliceous rock. Heat form dolerite and circulation of seawater hydrothermally altered the dolerite and surrounding sediments. A large volume of hydrothermal fluid must have circulated along dolerite-sediments boundary to dissolve minerals. Surrounding siliceous rocks are dolomitized, and also a reservoir. Mg and Ca were removed from the dolerite and precipitated in siliceous rock as dolomite. We expect similar dolerite reservoir to be discovered in other rift related basins where early submarine volcanic activities existed.