Pressure Cooking of Sediments

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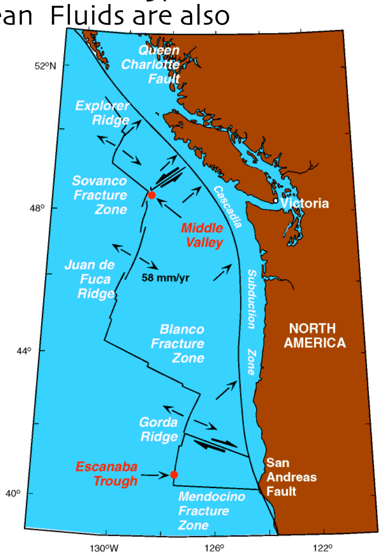
Sub seafloor hydrothermal activity in the form of fluid movement through permeable rocks and sediments transfers mass and energy between the oceanic crust and the ocean Fluids are also responsible for the transport and subsequent deposition of ore minerals on and beneath the seafloor The Escanaba Trough a sedimented portion of the slow spreading Gorda Ridge off the coasts of northern California and southern Oregon (Figure) was targeted by the Ocean Drilling Program (ODP) to study hydrothermal processes and their contribution to the development of ore bodies



Hydrothermal vents were previously reported around a recently uplifted sediment hill (Central Hill) in (see Morton et al) and many inactive sulfide deposits occur in the area These deposits were investigated by scientific drilling operations during ODP Leg in A number of holes were drilled in zones of known hydrothermal activity as well as in the center of Central Hill the dominant topographical feature at this site This ODP drilling provided new information that helped define the nature of the hydrothermal system information which could not be obtained using the shallower penetration allowed by gravity and piston coring Geochemical analyses of fluids extracted from sediment cores were an especially useful tool

The distribution of dissolved chloride and the ratio of potassium and aluminum (K/Al) in pore fluids and sediments of recovered cores were used by scientists to map sub surface variations in the hydrothermal alteration of sediments Differences in the distribution of K/Al for example are useful indicators of the historical temperature/pressure regimes of fluids interacting with the host sediment Leg experimental data provided important constraints on the processes of fluid flow along permeable pathways in hydrothermal systems at sedimented ridge crests

A model of the entire potential hydrothermal system at Escanaba Trough based on Leg results and previous work is shown in Figure Fluids with elevated chloride content move rapidly upward from depth through fault zones whereas fluids of low chloride content move in a lateral fashion through sandy horizons Massive sulfide is extensively exposed at the surface but thickness of the sulfide layers is apparently limited to the observed extent of the hydrothermal mounds above the seafloor (to m) and sulfide feeder veins were not encountered by drilling below the mounds These observations suggest that the hydrothermal event was relatively recent widespread and intense but was apparently of relatively short duration

That we are only observing the waning stage of this event is reinforced by the recent findings of Zierenberg et al ( ) Geochemical analyses of vent fluid samples taken on a revisit to Escanaba Trough in twelve years after Campbell et al ( ) sampled fluids from the hydrothermal vents showed evidence of a gradual waning of hydrothermal activity in the form of fewer actively discharging vents No significant changes in the temperature or salinity of the hydrothermal fluids were observed in vents that were still active It is puzzling that vents characterized by low chloride fluids have not been found in this area and that the salinity of the vent fluids has apparently been stable over a twelve year period given the large variation in pore fluid salinity in a very small area

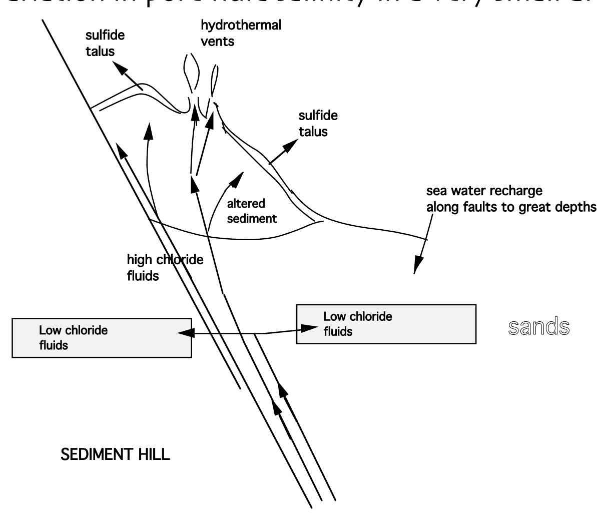


Figure A cartoon version of the potential hydrothermal system at Escanaba Trough

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