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Hydrothermal circulation on the active detachment fault at the TAG segment of the Mid-Atlantic Ridge (26N)

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he TAG hydrothermal field on the Mid-Atlantic Ridge at 26*N is widely recognized as the type example of an active, deep-sea massive sulfide deposit. It was initially believed that hydrothermal activity at TAG was driven by a crustal magma chamber, but a recent set of geophysical experiments have revealed that the TAG field is located on the hanging wall of an active detachment fault. Seismicity data demonstrates that the detachment fault is dome shaped and that it penetrates to mantle depths at an angle of ˜70\'a1 to the horizontal. These results, combined with seismic velocity data from the detachment footwall, indicate that the heat source driving convection is located at a depth of at least 7 km below the seafloor. Hydrothermal fluids must therefore travel long distances along the detachemt fault surface, both to extract heat from a deep reservoir, and to subsequently discharge at high-temperatures at the seafloor. The patterns of sub-surface circulation along the ˜20 km long detachment fault are not presently known, but upflow is known to occur along substantial portions of the southern half of the fault hanging wall. Rheological arguments suggest that much of the detachment may sole into a melt/mush zone, which in turn suggests that upflow may be occurring along nearly the entire length of the fault. However, recharge most likely occurs along at least some of the deep portions of the fault surface since permeabilities away from the fault zone at depth are presumably near zero.

These new developments have important implications for hydrothermal circulation on slow-spreading ridges. Detachment faulting has been shown to be ubiquitous on portions the Mid-Atlantic Ridge, and if these systems are associated with high-

temperature hydrothermal circulation in a general way, then it would appear that massive sulfide deposits may be far more common on slow-spreading ridges than previously supposed. This motivates a concerted effort to search for hydrothermal systems on the hanging wall of active detachment faults to determine if the TAG field is indeed representative of these geological systems.