9.3 Plume Detecting

The SM2000 was used to investigate how far off the sea floor the plume could be imaged acoustically. The test was performed by JASON moving laterally into the plume from clear water and then moving in 10 meter depth increments higher in the water column while remaining in the plume stem. The sonar gains were continuously adjusted to maintain an image of the plume. The plume was clearly detectable at low altitudes, 10 m off of the bottom, and the acoustic signature faded between 80 and 100 meters off the bottom. Although the plume is visible at low altitudes it did not affect bottom detection and mapping with the sonar.

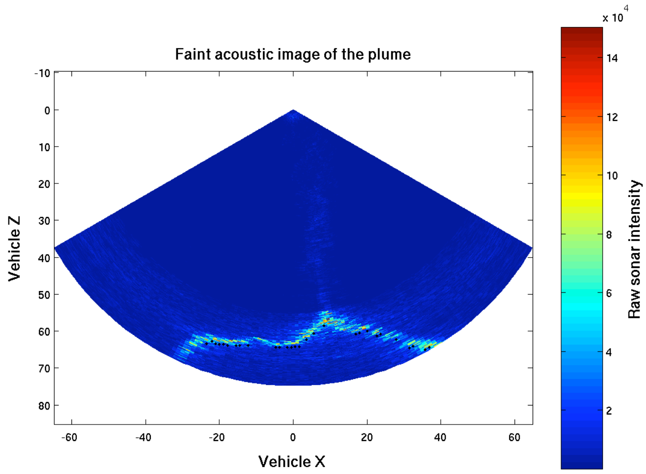

Figure 23. The TAG plume is visible in this sonar image rising from the peak in the seafloor.

10. Green Laser Testing
(Clifford Pontbriant)

Hydrothermal plume measurements are presently made via point source measurements of thermal, particulate, or chemical parameters. Thus it is necessary to pass the sensors directly through a plume to detect it. Clearly the search for hydrothermal plumes and thus deep-sea vent fields would be facilitated if plumes could be detected from a distance. Al Bradley and Rob Reves-Sohn are PIs on a WHOI funded project to develop a green laser system capable of detecting optical anomalies in hydrothermal plumes from a distance. Clifford Pontbriant is the primary lab technician for the project, and he took part in the dive program to perform initial testing of the prototype green laser source system. The instrument design consists of a pair of green lasers and an optical detector and scanning telescope. Each laser is mounted so the beam projects perpendicular to the vehicle, one to port, the other to starboard. The telescope and detector are mounted approximately one meter away from the lasers, and the telescope scans along the laser beams, looking for optical backscatter. The scanning telescope returns its orientation, so each backscatter signal will be assigned a position along the beam. This design offers an improved range over the point-source optical backscatter detector currently used in hydrothermal plume detection, particularly in finding the relatively narrow plume stem.

Determining the extent of this improvement was a primary goal of the TAG trials.

In order to test the concept rigorously and to take advantage of Jason's high bandwidth, the trial design incorporated a high sensitivity wide-angle camera as the light detector. The camera eliminated the need for a scanning telescope, and was sensitive enough for the job. The video feed from the camera was recorded and displayed in the Jason control van. Not only did the camera pose as a suitable detector, it gave instantaneous qualitative results that helped guide the survey process.

The top panel of Figure 24 is a plot of signal strength and angle from the vehicle (90° is normal to the vehicle, parallel to the beam) for thirty seconds of video from the first dive. This plot is analogous to the instrument's raw data. The bottom panel of Figure 24 is a plot from the same thirty seconds of video, but plotted against distance from the vehicle rather than angle. The backscatter signal is centered around 2.3 meters from the vehicle, off the starboard side. There is a faint signal 4.25 meters out at 20 to 25 seconds, but it is hard to pick up in this plot. Notice how the density of data points increases inversely with distance; a product of the geometries of the system.

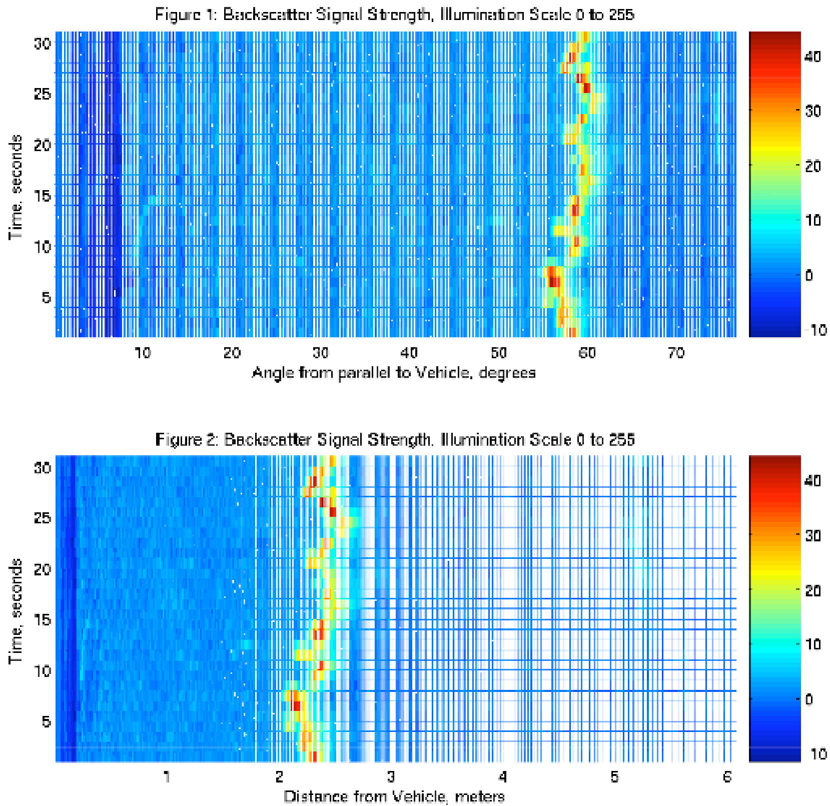

Figure 24. Green laser backscatter strength as a function of distance from the vehicle and time of flight.

Backscatter was observed from within two meters of the vehicle to beyond ten meters. The first trials came on the back of temperature probe recovery on the ocean bottom during the first dive. Backscatter was observed from terrain features, particles stirred by the vehicle, and, most importantly, black smokers. The second trials came during the second dive, and incorporated surveys of the buoyant plume stem fifty meters above the bottom. Strong backscatter was encountered in this region, which is very promising, since the usefulness of this instrument as a vent finding tool is its ability to detect the long, narrow plume stem.