**RESET06 (ATL15-6) Geology/Volcanology Team Report**

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**Objectives:**

1. Focus on time sensitive observations to characterize the eruption (visual and lava sampling for dating studies).
2. Use Alvin and TowCam (night program) to build on initial geological observations of the new eruption and begin to define its scope and effects following preliminary shipboard studies conducted on R/V Knorr and R/V New Horizon.
3. Collect data on the spatial extent, thickness, volume, and eruption conditions for the new lava flow within the AST and to its furthest distance off-axis.
4. Collect samples from throughout the new flow(s) for geochronological and petrological studies of eruption timing and conditions and to help constrain eruption dynamics. Rapid recovery of high-quality *in situ* samples is essential for short half-life 210Po-$^{210}$Pb eruption dating.
5. Find and attempt recovery of non-releasing OBSs presumed to be stuck in the new lava flow.
6. Investigate linkages between hydrothermal vent sites (new and old) and the new lava flow (including location of eruptive fissures and effects on AST structure).
7. Interface with investigators from other disciplines to understand the effects of the latest eruption on EPR ISS geological, hydrothermal and biological processes.

Expectations:

1. Fractions of each Alvin dive would be dedicated to lava mapping and sampling.
2. Collect 15-20 geographically well-distributed samples of the new lava flow(s) and characterize their geologic context and contact relationships (collect older lava at contacts).
3. Dedicate portions of several TowCam runs to OBS search, locate and attempt recovery.

***Initial Findings of the Knorr and New Horizon cruises and related laboratory studies:***

The Knorr cruise observed that OBSs in the EPR ISS were not responding and/or releasing to the surface. Fresh lavas were dredged south of the ISS Bull's-eye site and MAPRs tows showed temperature and particle anomalies near the sea floor. Lava sampling and camera tow work on the subsequent New Horizon cruise showed very fresh appearing lavas on the seafloor over roughly 15 km of ridge axis between 9° 47.5 and 9° 55.7'N. Preliminary radiometric dating of rocks recovered from both cruises indicate that materials erupted within the past year were recovered and that the new eruption may have been a sequence of events spanning about one year.

***New Observations and Discoveries on the RESET06 Cruise (AT15-6)***

- We have obtained unequivocal visual confirmation that very young lavas blanket a considerable portion of the seafloor throughout the EPR axis and crestal region between ~9° 46'-56'N.
- Visual observations of contact relationships within the new lava flow (i.e., 'newer lava' on top of 'new lava') support a multi-phase eruption sequence, consistent with preliminary Po dating results noted above.
- We found many similarities between the most recent (2005-2006) eruption(s) and the last major eruption documented in this area (1991-1992), including emplacement style, aerial extent, and decimation of existing hydrothermal/biological sites within the AST.
- Although broadly similar to the 1991-92 flow, the latest eruptions appear to be more voluminous. This latest event also appears to have erupted a greater volume of lava to the north (9˚ 53'-55'N), and in at least a few places TowCam surveys show that it extends to greater distances (as much as ~1.25 km in the 9° 49'-51'N area) from the AST. In other areas it erupted solely within the AST.
- In some places within the AST the new flow has completely covered previous markers, biologic communities, and instrumentation. Previously well-characterized geologic features within the AST were not easily recognized during Alvin dives or TowCam surveys.
- Hydrothermal activity continues to be more robust between 9˚ 47'-51'N than north of 9˚53'N.
- The eruption(s) north of 9˚53'N have a different eruptive/structural character. They are associated with a series of narrow discontinuous fissures rather than the continuous AST that exists in the 9˚ 47'-51'N area. In some cases lava has been extruded from the fissures, in others it has filled, but not overtopped the fissures. Some of the fissures are barren of fresh lava. Similar contact relationships were observed by Alvin in April 1992 for the 1991-92 eruption. Previous sidescan sonar mapping and Alvin diving on the EPR axis north of 9° 52'N confirm that it is marked by en echelon fissure swarms in this area.
- Areas where there is greater across-axis flow coverage also appear to have greater amounts of diffuse venting within the AST, possibly suggesting that these axial zones were sites where the eruption focused.
- The new eruption is clearly discontinuous along-axis and eruptive fissures may not have broken the surface along the entire length of ridge axis we investigated. The new flow is patchy and thin, particularly near the top of AST walls and within the floor of the AST.
- The new flows appear to be thin (~1 m thick) both within and proximal to the AST and on the EPR crestal plateau. This is somewhat paradoxical, given the need to efficiently move large volumes of lava across large distances of seafloor at high velocity, as inferred from the often sheet or folded morphology of the new lava surface. Pillow morphogies were only rarely observed and primarily at the termini of flow lobes.
- The new flow is asymmetric, with greater surface area covered east of the AST over the region between ~ 9° 49'-52'N where the greatest data coverage exists.
- Zones of significant off-axis transport of lava have ridge perpendicular channelized sheet flows for much of their length.
- In places, the off-axis extent of the lava is controlled by topographic obstructions of the preexisting lava surface (e.g. pillow ridges, faults, pressure ridges, etc.).

- An off-axis fissure eruption was documented at ~600m east of the AST at 9˚ 53'N. The lava flow it produced is primarily comprised of high effusion-rate morphology lavas (sheets, folded sheets and hackly lava surfaces), has limited colonization and no hot water venting was observed. The axis of the fissure ridge is marked by channelized sheet and curtain folded and hackly flows trending parallel to the ridge axis and some evidence for levee building along the margin of the channel. Orange-brown hydrothermal staining is prominent within the fissure ridge axis.
- This off-axis fissure ridge is very similar to a new fissure ridge investigated on CT#3 during the NH06 cruise at 9° 54.5'N, although the latter has a deep narrow eruptive fissure at its summit. New lavas from both fissure ridges ponded against the first off-axis fault east of the AST which is well documented in the sidescan sonar data for this area.
- The AST has changed (depth, width) in most of the locations we have measured it.
- Extant biological communities and some high temperature vents were covered by lava. In a few places, new flow covers the base of older chimneys and partially covers collapsed pieces of hydrothermal chimneys.
- None of the old Bio-Geo Transect Biomarkers deployed in 1992 were observed. HiT fluid loggers were recovered from M vent, Q vent and Ty vent, providing time series records that span from ~ 2 years before the eruption to a few months after it.
- The new lavas are very glassy and fresh looking; mostly aphyric and have very low vesicle contents (both crystal and vesicle contents are less than the 1991 flow based on shipboard hand specimen evaluation).
- Initial geochemical results suggest the new flow is a typical N-MORB derived from the same or similar source as the 1991-92 flows but that it is slightly more differentiated than the main 1991 flow.

***Outstanding Questions:***

- Was the eruption a single event, or did it comprise a series of pulses/episodes?
- What was the eruption duration?
- What is the total erupted volume and area covered?
- What causes large differences in erupted volume over short distances along axis?
- Does the eruption extend further south from 9˚ 46.3'N and/or further north of 9˚55.7'N (i.e., the limits established by the Alvin and TowCam surveys).
- Did the eruption concentrate in a few places, particularly where we observe a greater off-axis extent of new lava and areas of channelized flow?
- What is the intra-flow chemical heterogeneity of this eruption?
- What are the temporal and magmatic relationships between the off-axis fissure ridge eruptions (9° 53' to 54.5'N) to the axial eruptions.

***Basalt Samples Recovered:***

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| Young Flow | 13 | Probable Young Flow | 6 |
| Older Lavas | 1 | Probable Older Lavas | 7 |

***TowCam Bottom Observations:*** ~27 hours during 7 lowerings