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Mission Number: R/V Western Flyer Expedition 2983
Dive Numbers: T737-841

Title: The geological and geochemical development of Endeavour Axial Ridge Volvano

Principal Investigator: Gill
Other Participating Investigators: Stakes, Perfit

SUMMARY OF CRUISE RESULTS: FIVE 13-HOUR DIVES WERE COMPLETED WITHIN THE 4 KM WIDE, 5 KM LONG CENTRAL THIRD OF THE ENDEAVOUR SEGMENT, BOTH IN THE AXIAL VALLEY AND ACROSS THE FLANKS OUT TO AMBIENT SEA FLOOR DEPTHS (~2300M). WE WERE STRUCK BY THE SIMILARITIES WITH (NOT DIFFERENCES FROM) THE CLEFT SEGMENT -- ENDEAVOUR IS NOT MAGMATICALLY DEAD. OFF-AXIS VOLCANISM IS ABUNDANT ON BOTH FLANKS DESPITE THERE BEING AN AXIAL MAGMA CHAMBER BENEATH ONLY THE EASTERN FLANK. THE TWO FLANKS APPEAR TO MIRROR IMAGES OF ONE ANOTHER GEOLOGICALLY APART FROM YOUNG SHEET FLOWS ON THE AMBIENT SEA FLOOR TO THE EAST BUT NOT WEST. MAPPABLE UNITS APPEAR COHERENT FOR >1 KM ALONG STRIKE IN THE AXIAL VALLEY AND ON THE FLANKS. SEDIMENT IS ABUNDANT IN THE WATER COLUMN EVERYWHERE AND THE SEDIMENT COVER IS SIMILAR IN THE AXIAL VALLEY AND ON THE FLANKS OUT TO >2 KM OFF-AXIS. THERE IS AN APPARENT CONTRAST IN ERUPTION STYLE BETWEEN AXIS (SHEETS, LOBATES, AND COLLAPSE FEATURES PARALLEL THE VALLEY AXIS) VERSUS FLANK (CIRCULAR PILLOW TUBES ORTHOGONAL TO THE AXIS). NEW AREAS OF ACTIVE DIFFUSE HYDROTHERMAL VENTING WERE FOUND BETWEEN THE HIGH RISE AND MAIN FIELDS, AND OLD VENT FIELDS WERE FOUND ON THE FAULT SCARPS OF THE AXIAL VALLEY, BUT NO EVIDENCE OF ACTIVE VENTING WAS FOUND OFF-AXIS. WE COLLECTED ~175 ROCK SAMPLES DENSELY ENOUGH TO POTENTIALLY ASSES WHETHER HIGH-RESOLUTION BATHYMETRY CAN MAP CHEMICALLY-COHERENT BASALT UNITS, WHETHER APPARENTLY ON-AXIS LAVAS DIFFER CHEMICALLY FROM APPARENTLY OFF-AXIS ONES, AND WHETHER EITHER VARY SYSTEMATICALLY IN COMPOSITION ALONG OR ACROSS AXIS.

GENERAL SCIENTIFIC CONTRIBUTION OF THE CRUISE: WE CONCLUDE THAT VOLCANISM HAS BEEN ACTIVE BOTH WITHIN THE AXIAL VALLEY AND ON THE FLANKS OF ENDEAVOUR. ALTHOUGH WE FOUND NO EVIDENCE ANYWHERE OF "RECENT" VOLCANISM (WITHIN THE LAST FEW DECADES), VOLCANISM EVERYWHERE COULD BE HOLOCENE IN AGE. AXIAL VALLEY WALLS UP TO 1 KM OFF AXIS APPEARED TO BE STEPS OF IN TACT BUT VARIABLY FRACTURED

SHEET, LOBATE, AND HACKLY LAVA FLOWS SIMILAR TO THE YOUNGEST LAVAS SEEN IN COLLAPSE FEATURES IN THE AXIS. ON THE WALLS, THEY ARE VARIABLE COVERED BY PILLOW LAVAS THAT APPEAR TO HAVE BEEN ERUPTED OFF AXIS. COVERAGE BY PILLOW TERRANE INCREASES WITH DISTACE OFF AXIS AND BECOMES COMPLETE AFTER 1 KN. THE SIMILARITY OF THE TWO FLANKS SUGGESTS THAT THE ASSYMETRIC AXIAL MAGMA CHAMBER MAY BE SHORTER-LIVED THAN THE OFF-AXIS VOLCANISM. SAMPLES SEEM SUFFICIENT TO SUPPORT LATER LAB WORK THAT WILL TELL ABOUT THE DIVERSITY AND HOPEFULLY AGE OF MAGMA BATCHES AND LENSES.

SPECIFIC ADVANTAGES OF RESEARCH TO NURP: WE COMPLETED THE FIRST THOROUGH CHARACTERIZATION OF THE VOLCANOLOGICAL AND GEOLOGICAL UNDER-PINNINGS OF THE HYDTOTHERMAL FIELDS AT ENDEAVOUR TO DATE, AND WE COLLECTED THE FIRST SYSTEMATIC LAVA SAMPLES WITH WHICH TO UNDERTAKE GEOLOGICAL AND GEOCHEMICAL MAPPING OF THE REGION. FUTURE INVESTIGATIONS WILL HAVE A BASELINE STRUCTURAL, PETROLOGICAL, AND STRATIGRAPHIC CONTEXT WITHIN WHICH TO ORIENT DETAILED STUDIES.

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