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The Importance of Core-log Integration in Calculations of Element Budgets; Mariana Subduction Factory, ODP Leg 185, Site 801C

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Subduction zones are the loci of many dynamic geological processes. They represent the main regions where crustal recycling takes place, and through time they have provided a setting for the formation of the continents. A number of key elements, stored in the sedimentary column (Th, REE, Ba, Be) or in the upper, oxidised volcanic sections of oceanic basement (K, B, U, CO_2, H_2O), can be used as tracers to help us understand crustal growth and recycling. The main objective of ODP Leg 185 was to determine the geochemical composition of the inputs to the West Pacific Subduction Factory for use in calculations of elemental mass balance across the subduction zone. To understand such elemental budgets, it is critical to know the lithological diversity and chemical characteristics of the down going oceanic plate. Site 801C, located ocean-ward of the Mariana island arc system, was first drilled during ODP Leg 129, penetrating 50 m into tholeiitic basement (Lancelot et al., 1990). It was re-entered and deepened to 935.70 mbsf (meters below seafloor) during ODP Leg 185, providing the most complete section of old oceanic crust (~165 Ma) to date.

Drilling provides samples from the volcanic layer, which give us clear constraints on the structure and composition of the oceanic crust. However, core recovery in basement holes is often poor (< 50%) and may induce a strong biasing, such that the more competent, less altered material is preferentially recovered. This relatively "unaltered" recovered core then produces erroneous estimates of the lithologies and bulk compositions input into mass balance calculations. Moreover, key elements that are important in mass balance calculations such as Th, U, K or the Rare Earth Elements are often stored in the most altered, less competent parts of the volcanic pile. In order to achieve the ODP Leg 185 goals, a reconstruction of the proportions and the chemistry of each lithology within Hole 801C is required. Downhole logging data offer an opportunity to address such problems through detailed integration of log and core data.

Based on core description, the lithological sequence in Hole 801C consists of pre-dominantly aphyric, massive, fractured or brecciated basalt. The basalts are intercalated with thin layers of sediment or recrystallised material, and two hydrothermal deposits. Recovery averaged 47%, good for a basement hole, however over half the lithological sequence remains unaccounted for. Downhole logging provides a continuous record of the physical, chemical and electrical properties of the borehole walls; and core material has been used to calibrate the log data, allowing us to predict the lithology where recovery is incomplete and giving us an appreciation of the extent of the lithological bias in core acquisition.

This contribution presents results from core-log integration, using resistivity, density, porosity, velocity, image logs (Formation Micro Scanner) and U, Th and K concentrations derived from the natural gamma ray tool, in conjunction with core description, digital core images and shipboard physical properties measurements. K is known to be a mobile element during sea-floor alteration and as such it provides a proxy in the identification of alteration zones. In contrast, Th is not easily mobilised during alteration and it may therefore provide information of the original volcanic compositions. U is mobile under oxidising conditions and is precipitated in reducing environments and as such it may provide a potential discriminator for the different styles of alteration. Careful examination of the cores and log data allowed us to define criteria to identify the different lithologies such as the massive basalt units, fragmented basalt units, which may correspond to pillow basalts, and brecciated units. There does appear to be a lithological bias in core acquisition, with missing core intervals corresponding mainly to brecciated units that are less resistive and less massive with lower densities, higher porosities and higher gamma-ray values. The difference between lithological proportions calculated from core data and log data highlights the importance of using logging data for an accurate estimation of the ocean crust structure and composition.

Lancelot Y, Larson RL, et al., *Proc ODP Init. Reps.*, **129**, (1990).