Barriga, F.J.A.S., Binns, R.A., Miller, D.J., and Herzig, P.M. (Eds.)
Proceedings of the Ocean Drilling Program, Scientific Results Volume 193

5. DATA REPORT: SUMMARY OF ALTERATION PHASES DETECTED BY SPECTROSCOPIC ANALYSIS OF ALTERED FELSIC VOLCANIC ROCKS FROM ODP LEG 193, HOLES 1188A, 1188F, AND 1189A[1]

Ian Warden[2]

ABSTRACT

This report presents short-wave infrared spectroscopic data acquired from both core and powdered samples collected during Ocean Drilling Program Leg 193, from Holes 1188A, 1188F, and 1189A, using a Portable Infrared Mineral Analyzer reflectance spectrometer. The distribution of alteration minerals detected using this method for each site is presented.

INTRODUCTION

During Ocean Drilling Program Leg 193, a series of holes was drilled within the PACMANUS hydrothermal field located along the Pual Ridge in the Manus Basin, within the territorial waters of Papua New Guinea. This cruise aimed to investigate the three-dimensional nature of the volcanic architecture and structural, hydrological, alteration, and mineralization patterns of an active felsic-hosted hydrothermal system in a backarc basin setting. The area contains zones of low-temperature diffuse hydrothermal venting and high-temperature focused venting with associated sulfide chimneys. A detailed description of the geological setting of this area may be found in Binns, Barriga, Miller, et al. (2002).

Short-wave infrared (SWIR) spectrometry was conducted on board the *JOIDES Resolution* during Leg 193 and during postcruise research to

---

[1] Warden, I., 2005. Data report: Summary of alteration phases detected by spectroscopic analysis of altered felsic volcanic rocks from ODP Leg 193, Holes 1188A, 1188F, and 1189A. *In* Barriga, F.J.A.S., Binns, R.A., Miller, D.J., and Herzig, P.M. (Eds.), *Proc. ODP, Sci. Results,* 193, 1–10 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/193_SR/VOLUME/CHAPTERS/204.PDF>. [Cited YYYY-MM-DD]

[2] Nautilus Minerals Corporation, C/-GPR, Level 3, 74 Castlereagh Street, Sydney NSW 2000, Australia.
Ian.Warden@cna.riotinto.com.au

Initial receipt: 19 May 2003
Acceptance: 6 August 2004
Web publication: 19 January 2005
Ms 193SR-204

aid the identification of fine-grained alteration minerals and to help to delineate their mineralogical assemblage. The results of the spectroscopic analysis of core material and powdered samples from Sites 1188 and 1189 are presented in this report. Site 1188 was drilled in a zone of hydrothermal activity characterized by lower-temperature, more diffused venting at the Snowcap site. Site 1189 was drilled in an area of hydrothermal activity characterized by higher-temperature, more focused venting with associated sulfide chimneys and known as Roman Ruins.

METHODS

Spectroscopic analyses were conducted on samples recovered from Holes 1188A, 1188F, 1189A, and 1191A. No onboard analyses were conducted on samples from Hole 1189B or powdered samples from Hole 1188F due to equipment malfunction.

The spectroscopic analyses were conducted using an Integrated Spectronics Portable Infrared Mineral Analyzer (PIMA) II, measuring the spectral range between 1300 and 2500 nm, in 2-nm increments.

The analyses were conducted on samples taken directly from the cores and on the powders produced for onboard X-ray diffraction (XRD) analyses. Core samples were analyzed after they were air-dried in the core trays. A 1-cm^2 area of the core was analyzed where possible every 10 cm. Additional measurements were taken when features of additional interest such as vein material, alteration halos, and other areas of distinct alteration were observed. Powdered samples were measured in a petri dish with the PIMA calibrated to eliminate the effects of measurement through the glass.

Qualitative analyses of the spectra acquired were conducted using the “Integrated Spectronics PIMAView 3.1” software, combined with visual analysis of the sample spectra. Analysis of the spectra was carried out using hull-corrected data. All reflectance spectra were processed to remove the reflectance hull by applying a baseline “hull quotient” correction to the spectral data (Pontual et al., 1997). Relative abundance of each mineral identified was calculated applying the ratio of the hull-corrected depth of each mineral’s diagnostic absorption feature and the overall range of the hull-corrected range for each spectra. More sophisticated methods for determining mineral abundance were not employed because of the generally poor quality of the spectral data. Illite composition was calculated by determining the position of the primary AlOH absorption feature occurring between 2180 and 2220 nm. AlOH absorptions occurring around 2180 nm in samples containing illite generally suggest a paragonitic illite composition, with absorptions around 2205 nm suggesting a “normal” potassic composition and absorptions around 2220 nm suggesting a more phengitic composition (Pontual et al., 1997).

RESULTS

Core sample analysis SWIR spectrometry was most successful with samples from Holes 1188A, 1188F, and 1189A. Little success was achieved with samples from Sites 1190 and 1191 because of the glassy nature of the material. Mechanical malfunctions of the PIMA resulted in impossibility to analyze the XRD powders from Hole 1188F or any material from Hole 1189B.

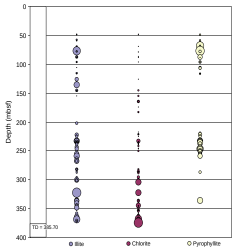
Illite, chlorite, and pyrophyllite were the major clay minerals identified during qualitative analysis of the data. All three minerals were found in samples from Snowcap (Site 1188), while only illite and chlorite were detected at the high-temperature Roman Ruins (Site 1189). The distribution of these minerals at each of the sites is shown in Figures F1 and F2. Spectroscopic data for both of these sites are presented in Tables T1 and T2. The composition of illite at Site 1188 ranges between paragonitic to potassic. In Hole 1188F, a distinct trend is shown by illite, which becomes more potassic in composition with depth (Fig. F3). At Site 1189, illite was generally potassic in composition (Fig. F4).

ACKNOWLEDGMENTS

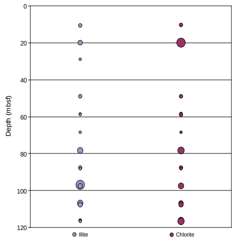
This report presents data acquired from samples provided by the Ocean Drilling Program (ODP). During Leg 193, the author acted as an industry observer on behalf of Nautilus Minerals Corporation, which holds exploration title over the area within which drilling operations were conducted.

This research used samples and/or data provided by the Ocean Drilling Program (ODP). ODP is sponsored by the U.S. National Science Foundation (NSF) and participating countries under management of Joint Oceanographic Institutions (JOI), Inc. Equipment for this research was provided by the Commonwealth Scientific & Industrial Research Organisation of Australia.

F1. Summary of alteration phases, Site 1188, p. 5.



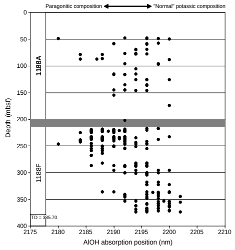
F2. Summary of alteration phases, Site 1189, p. 6.



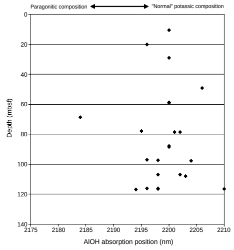
T1. PIMA analyses, Holes 1188A and 1188F, p. 9.

T2. PIMA analyses, Hole 1189A, p. 10.

F3. Illite composition, Site 1188, p. 7.



F4. Illite composition, Site 1189, p. 8.



REFERENCES

Binns, R.A., Barriga, F.J.A.S., Miller, D.J., et al., 2002. *Proc. ODP, Init. Repts.,* 193 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

Pontual, S., Merry, N., and Gamson, P., 1997. *Spectral Analysis Guides for Mineral Exploration: G-MEX Manuals* (Vols. 1–8): Victoria, Australia (AusSpec International).

Figure F1. Summary of alteration phases detected at Site 1188. The width of each dot on the graph indicates the abundance of each mineral as determined by qualitative analysis. TD = total depth.

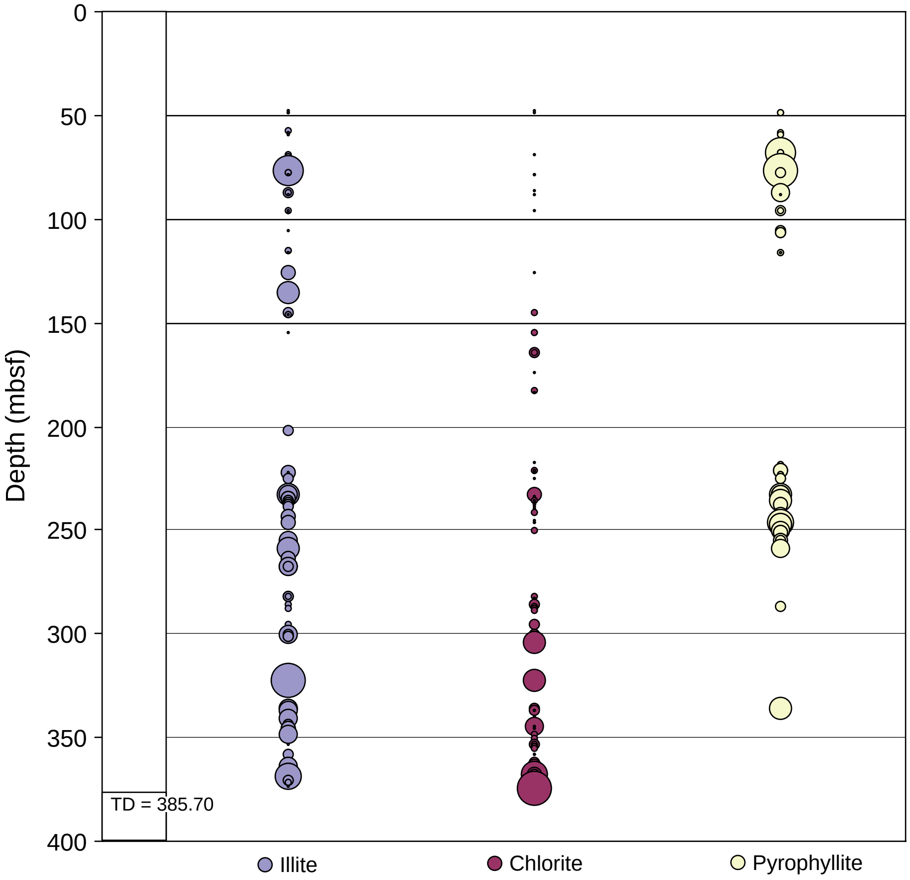


Figure F2. Summary of alteration phases detected in Hole 1189A. The width of each dot on the graph indicates the abundance of each mineral as determined by qualitative analysis.

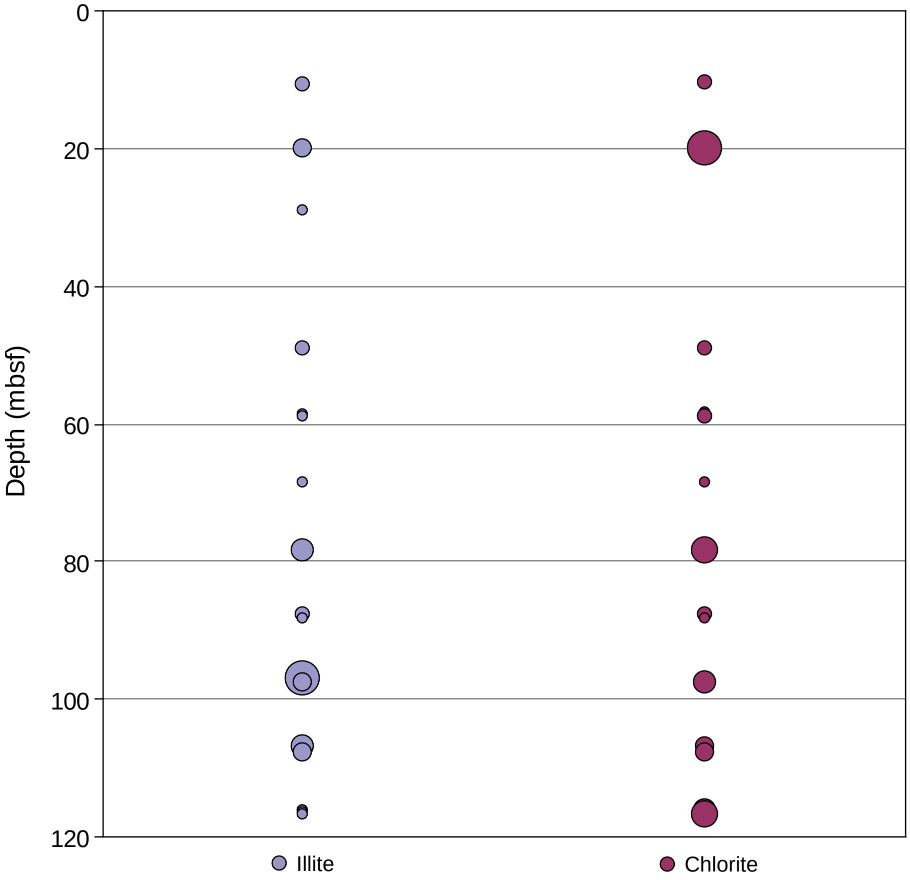


Figure F3. Illite composition at Site 1188 as suggested by the position of the primary AlOH absorption around 2180–2220 nm. TD = total depth.

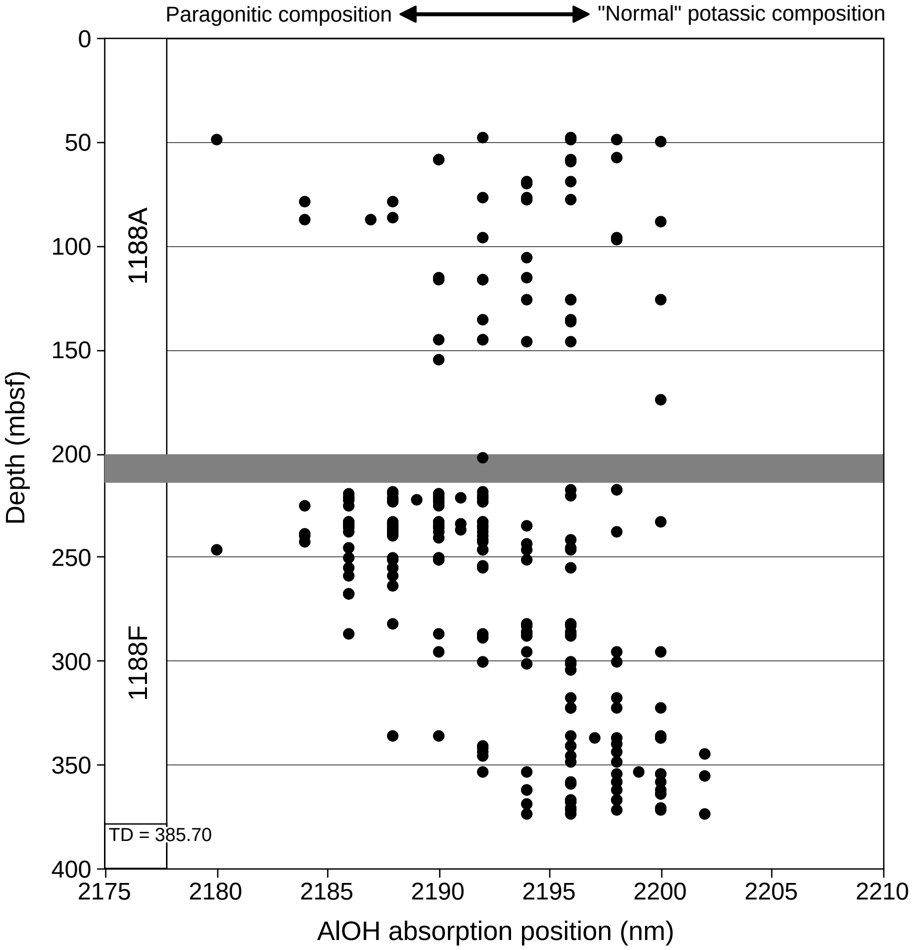


Figure F4. Illite composition in Hole 1189A as suggested by the position of the primary AlOH absorption around 2180–2220 nm.

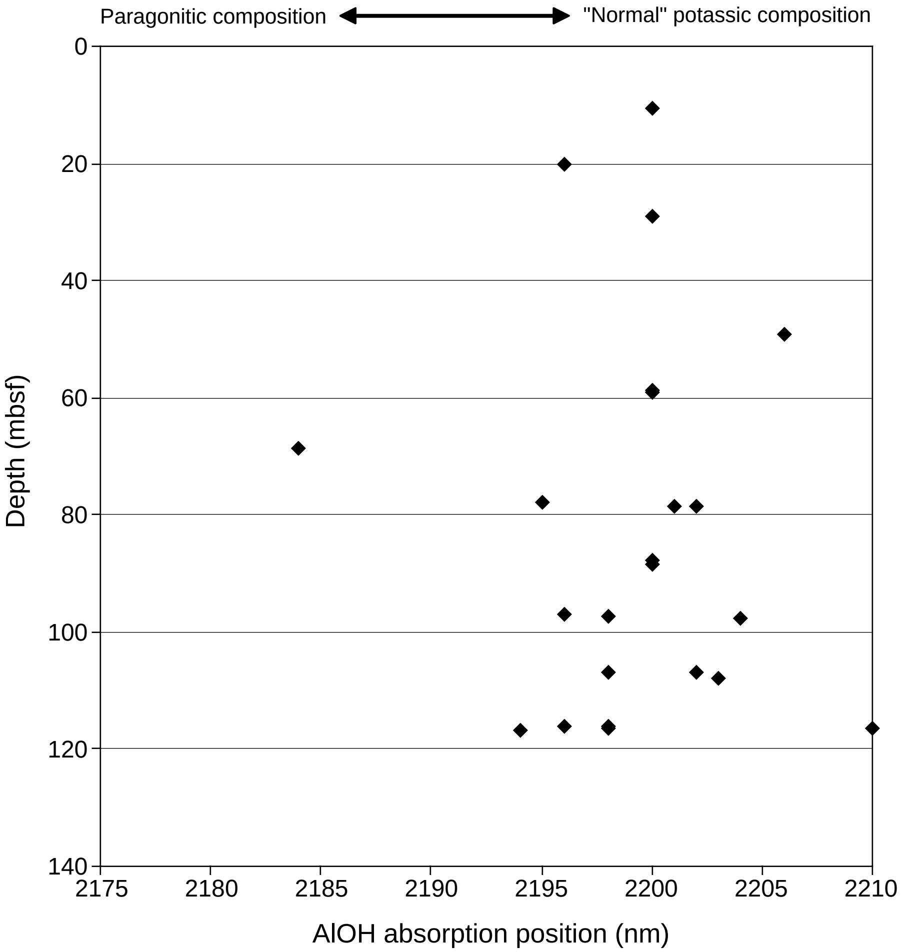


Table T1. PIMA analysis, Holes 1188A and 1188F. (This table is available in an oversized format.)

Table T2. PIMA analyses, Hole 1189A. (This table is available in an **oversized format.**)