

**Berichte - Reports
Institut für Geowissenschaften**

Nr. 17



Stoffers, P.; Worthington, T.; Petersen, S.; Hannington, M.;
Türkay, M.; Ackerman, D.; Borowski, C.; Dankert, S.; Fretzdorff,
S.; Haase, K.; Hekinian, R.; Hoppe, A.; Jonasson, I.; Kuhn, T.;
Lancaster, R.; Monecke, T.; Renno, A.; Stecher, J.;
Weiershäuser, L.

**Cruise Report SONNE 157
FOUNDATION 3**

Magmatic and Hydrothermal Processes at a Spreading Axis influenced
by a Hotspot: the Pacific – Antarctic Ridge and Off-Axis Seamounts
near 37°S

Magmatische und Hydrothermale Prozesse einer Spreizungsachse im
Einflussbereich eines Hotspots: der Pazifisch – Antarktische Rücken
und die Off-Axis Seamounts bei 37°S

Valparaiso, Chile – Easter Island, Chile
15 June – 14 July 2001

Ber. - Rep., Inst. für Geowiss., Universität Kiel, Nr. 17,
132 S., 21 Abb., 11 Tab., 4 Taf., Kiel, (Dezember) 2001.

ISSN 0175-9302

TABLE OF CONTENTS

	Page
1 Summary.....	1
2 Acknowledgements.....	3
3 Participants.....	3
4 Introduction.....	5
<i>P. Stoffers, T. Worthington, K. Haase, S. Petersen</i>	
4.1 Cruise Objectives	5
4.2 Cruise Narrative	8
4.3 References	10
5 Petrology.....	11
<i>T. Worthington, R. Hekinian, K. Haase, A. Renno, P. Stoffers, S. Fretzdorff, L. Weiershäuser, A. Hoppe, R. Lancaster</i>	
5.1 Introduction	11
5.2 Northern PAR Area ($37^{\circ}33'$ – $38^{\circ}35'$ S)	12
5.2.1 Northern axial high ($\sim 37^{\circ}40'$ S)	12
5.2.2 Central axial high ($\sim 37^{\circ}48'$ S)	15
5.2.3 Northern PAR crest ($37^{\circ}54'$ – $38^{\circ}35'$ S)	15
5.2.4 Off-axis seamount: the central Foundation chain at $37^{\circ}42'$ S	16
5.2.5 Off-axis seamounts: the southern Foundation chain near $38^{\circ}15'$ S	17
5.3 Southern PAR Area ($39^{\circ}30'$ – $41^{\circ}43'$ S)	17
5.3.1 Southern PAR crest ($39^{\circ}30'$ – $41^{\circ}23'$ S)	17
5.3.2 Off-axis seamount: the southern overlap basin at $41^{\circ}22'$ S	20
5.3.3 Next major segment to the south ($41^{\circ}29'$ – $41^{\circ}43'$ S)	21
5.4 Summary and Unresolved Issues	21
6 Seafloor Observations and TV-Grab Sampling.....	23
<i>S. Petersen, M. Hannington, T. Kuhn, T. Monecke, S. Dankert</i>	
6.1 Northern Axial High (PAR $37^{\circ}40'$ S)	23
6.1.1 Summary	23
6.1.2 Structure	23
6.1.3 Volcanism	27
6.1.4 Hydrothermal activity and fauna	28
6.1.5 Mineralization	28
6.2 Central Axial High (PAR $37^{\circ}47.5'$ S)	30
6.2.1 Summary	30
6.2.2 Structure	33
6.2.3 Volcanism	33
6.2.4 Hydrothermal activity, fauna and mineralization	34
6.3 Hydrothermal Activity at an Off-axis Seamount ($37^{\circ}42'$ S)	35
6.3.1 Summary	35
6.3.2 Structure	37
6.3.3 Volcanism	37
6.3.4 Hydrothermal activityand mineralization	39

6.4	The Pacific–Antarctic Ridge at 39°25'S	40
6.4.1	Summary	40
7	Mineralization and Alteration.....	42
	<i>I. Jonasson, M. Hannington, A. Renno, T. Monecke, R. Lancaster</i>	
7.1	Alteration at the Off-axis Seamount (37°42'S)	42
7.1.1	Detailed descriptions: Station 08-GTV	42
7.1.2	Detailed descriptions: Station 09-GTV	43
7.2	Mineralization and Alteration at the Central Axial High (PAR 37°47'S)	43
7.2.1	Detailed descriptions: Station 31-GTV	43
7.2.2	Detailed descriptions: Station 33-GTV	44
7.3	Mineralization and Alteration at the PAR, 39°25'S	47
7.4	Implications for Mineralization along the Pacific–Antarctic Ridge	48
8	Manganese Oxides.....	49
	<i>T. Kuhn</i>	
9	Magmatic Sulfides.....	51
	<i>D. Ackerman, R. Hekinian</i>	
10	Biological Investigations.....	53
	<i>M. Türkay, J. Stecher, C. Borowski</i>	
10.1	Overview	53
10.2	Station 01-OFOS	55
10.3	Station 20-OFOS	57
10.4	Station 25-OFOS	58
10.5	Station 30-GTV	59
10.6	Station 66-OFOS	60
10.7	Analyses of Symbioses	63

		Page
List of Figures		Page
Fig. 4.1:	Tectonic setting, bathymetry and working stations on the PAR	6
Fig. 5.1:	Bathymetry and dredge stations in the northern working area, PAR 37°30'–38°40'S	14
Fig. 5.2:	Bathymetry and dredge stations in the northern part of the southern working area, PAR 39°25'–40°20'S	18
Fig. 5.3:	Bathymetry and dredge stations in the southern part of the southern working area, PAR 41°00'–41°40'S	19
Fig. 6.1:	Bathymetry and station tracks across the northern axial high of the PAR	25
Fig. 6.2:	Geological survey for the northern axial high of the PAR	26
Fig. 6.3:	Potential temperature and depth profile over time for station 01-OFOS	29
Fig. 6.4:	Potential temperature and depth profile over time for station 20-OFOS	29
Fig. 6.5:	Bathymetry and station tracks across the central axial high of the PAR	31
Fig. 6.6:	Geological survey for the central axial high of the PAR	32
Fig. 6.7:	Potential temperature and depth profile over time for station 25-OFOS	35
Fig. 6.8:	Bathymetry and station tracks across the off-axis seamount (37°42.5'S)	36
Fig. 6.9:	Geological survey of the off-axis seamount summit crater	36

Fig. 6.10:	Instrument depth vs time for station 10-GTV	38
Fig. 6.11:	Instrument depth vs time for station 08-GTV	38
Fig. 6.12:	Instrument depth vs time for station 66-OFOS	40
Fig. 6.13:	Bathymetry and station track at the PAR ($39^{\circ}25'S$)	41
Fig. 7.1:	Sample location and distribution for the large chimney fragment recovered at Station 33-GTV	44
Fig. 7.2:	Cross-section and schematic views through nested fossilised shells of sample 33-GTV-2	46
Fig. 9.1:	Magmatic sulfides in SO 157 lavas	52
Fig. 10.1:	Specimens of PAR <i>Bathymodiulus</i> from $38^{\circ}S$ designated for analyses of symbioses	64

List of Tables	Page
Table 5.1: Petrology samples and lithologies	13
Table 6.1: Summary of OFOS stations	24
Table 6.2: Summary of TV-grab stations	24
Table 8.1: Sample stations with Mn oxides	49
Table 9.1: Representative analyses of sulfides coating vesicle walls	51
Table 10.1: Biological samples obtained during cruise SO 157	54
Table 10.2: Biological narrative of 01-OFOS	55
Table 10.3: Biological narrative of 20-OFOS	58
Table 10.4: Biological narrative of 25-OFOS	59
Table 10.5: Biological narrative of 30-GTV	60
Table 10.6: Biological narrative of 66-OFOS	61

List of Appendices	No. of Pages
Appendix 1: Shipboard Scientific Party Contact Details	2
Appendix 2: Petrology Stations and Sample Descriptions	13
Appendix 3: OFOS and TV-Grab Descriptions	48

List of Plates	
Plate 1:	Geological Map of the Northern Axial Ridge
Plate 2:	Geological Map of the Central Axial High
Plate 3:	Geological Map of the $37^{\circ}42'S$ (SCAMPI-04) Foundation Seamount
Plate 4:	Geological Map of the Pacific–Antarctic Ridge at $39^{\circ}25'S$