

Microchemical Analysis of minerals from the Tsukiyoshi Fault zone in the Tono Mine and MIU-2 borehole

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三菱商事株式会社

要 旨

MIU-2号孔, MIU-3号孔およびMIU-4号孔を対象として, 月吉断層の調査を行った。この調査の主要な目的は以下の通りである;

- ・土岐花崗岩中において, 断層を系統的に同定し, 記録するとともに, 水理学的に重要な特徴を抽出する。
- ・月吉断層の構造に関する概念モデルの構築を行うための基礎データの提供として, 地質, 地質構造, 鉱物に関するデータをとりまとめる。
- ・正馬様用地に分布する土岐花崗岩中での断層の形成発達に関する考察を行う。

調査の結果, 対象ボーリング孔の地質構造アトラスが作成された。また, MIU-4号孔については, 岩相と鉱物組成および地質構造の解析結果に基づいて, 個別の水理地質帯に区分した。

MIU-2号孔とMIU-4号孔の観察により, 月吉断層の活動および断裂を埋める鉱物形成は7つの段階に区分された。

また, MIU-2号孔とMIU-4号孔では, 地下水流動経路となりうる地質構造の特徴を記載した。この結果, このような特徴として以下の2種類が認められた;

- ・開口割れ目によるもの。
- ・部分的に微小割れ目の発達する花崗岩中での方解石の溶解や微小割れ目に伴う空隙の多いゾーンによるもの。

本報告書は, 三菱商事株式会社が核燃料サイクル開発機構との契約により実施した業務成果に関するものである。

Microchemical Analysis of minerals from the Tsukiyoshi Fault zone in the Tono Mine and MIU-2 borehole.

Mitsubishi Corporation

Abstract

The Tsukiyoshi fault intersections in the boreholes MIU-2, MIU-3 and MIU-4 were investigated with following main purposes;

- (1) to systematically identify and record the distribution of fault intersections, and features of potential hydrogeological significance.
- (2) to compile and integrate geological, structural, mineralogical observations in a "structural atlas" form in order to provide data to enable the development of a conceptual model of the geometry and architecture of the Tsukiyoshi Fault, and its associated fracture envelope.
- (3) to provide further insights into the age relationships of the faults and fracture mineralisation history of the Toki Granite at the Shobasama site.

As a result, a structural atlas graphic has been prepared for each holes. In addition, the data for MIU-4 have been interpreted to produce a further borehole graphic, which divides the Toki Granite and the Tsukiyoshi Fault into a series of discrete hydrogeological domains based on a combined consideration of the lithology, mineralogical evidence for groundwater movement and alteration characteristics, as well as the structural domain interpretation.

The additional observations recorded from MIU-2 and MIU-4 have also enabled the relative history of faulting and fracture mineralisation to be refined further. Seven broad fracturing events can now be distinguished.

The distribution of features considered to represent potentially flowing features has been systematically recorded from MIU-2 and MIU-4. This study now distinguishes two types:

- potentially flowing features associated with open fractures.
- potentially flowing features associated with zones of porous and friable granite formed by the dissolution of earlier calcite veins and microfractures, within locally intensely microfractured granite.

This work was performed by Mitsubishi Corporation under contract with Japan Nuclear Cycle Development Institute.

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1 Introduction

This report presents the result of a mineralogical study conducted on drillcore samples from the Tsukiyoshi Fault zone from the MIU-2 borehole and the Tono Mine. Mineralogical analyses were carried out by electron probe microanalysis (EPMA) on seven samples (Table 1).

2 Method

2.1 Sample preparation

The EPMA analyses were all carried out at the British Geological Survey on polished thin sections. For this study the polished thin sections were carbon-coated prior to analysis. One sample (D903) is not in the form of a thin section but was a polished block of rock-chip mounted in resin. However this sample was treated in the same way for EPMA analysis.

2.2 Analytical techniques

The EPMA analyses were obtained using a Cameca SX50 wavelength dispersive electron microprobe. The rocks were analysed using an accelerating potential of 15kV and a 20nA beam current. A beam of diameter $\sim 0.25\mu\text{m}$ was used, however for some heat-sensitive minerals (e.g. calcite) the beam was broadened or 'defocused'. For example, a beam of diameter $12\mu\text{m}$ was used for the calcite analyses and $5\mu\text{m}$ for K-feldspar. Elements were analysed using the PET, LiF and TAP diffracting crystals, calibrated using well-characterised mineral standards, pure metals and synthetic oxides. The following oxides were determined by stoichiometry for each minerals: SiO_2 , TiO_2 , Al_2O_3 , FeO , MnO , MgO , Na_2O , P_2O_5 , BaO , SrO and Rb_2O . Due to interference effects from the large Si peak, the measured SrO data has had the following empirically derived correction factor applied:

$$\text{SrO (corrected)} = \text{SrO (measured)} - (\text{SiO}_2 \text{ (measured)} * 0.0062)$$

Thus the SrO data is presented as SrO (measured) and SrO (corrected), and the Total for each analysis is presented as Total (measured) and Total (corrected).

3 Results

Table 1 provides a summary of the EPMA analysis of the samples from the Tsukiyoshi Fault zone. The full data are presented in Table 2.

Note that some of the analysis totals are lower than would be expected from pristine fresh minerals (e.g. some feldspars totals are $<98\%$, and the majority of the biotite totals are $<95\%$) and this reflects analysis of primary minerals which have been altered to secondary composition (e.g. biotite altered to chlorite or clay minerals; feldspar altered to mica) and also have a significant degree of intracrystalline microporosity.

Table 1: Summary of microprobe analysis

Borehole	Sample code	Analyses	Minerals analysed
98SI-03	D899	n=32	K-feldspar, altered biotite, matrix clay, plagioclase
98SI-03	D903	n=17	calcite veins, ?zeolite/altered feldspar; the low number of analyses reflects the overall fine grained nature of sample.
98SI-03	D902.1	n=29	feldspar clasts, calcite ('fibrous' vein type and nodular-in-vein type), sheared matrix clay
98FE-01	F522	n=29	altered biotite, K-feldspar, ?muscovite, plagioclase, ?chlorite
TH-2	F547	n=33	calcite ('fibrous' vein type and vein-core type), epidote, chlorite
MIU-2	F558	n=49	plagioclase, K-feldspar, altered biotite, calcite
TM-2	F534	n=28	altered biotite, plagioclase, muscovite, matrix clay, ?chlorite

The Appendix contains an annotated image of each sample illustrating each analysis location/area. These locations can be matched with the corresponding analyses by using the number given in the column in Table 2 marked 'Location'

Table 2: Microprobe Analyses

Borehole	Sample Code	Location	Mineral	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Rb2O	SrO (measured)	SrO (corrected)	BaO	F	Total (measured)	total (corrected)
98SI-03	D899	1	K-feldspar	64.48	0.00	18.21	0.00	0.07	0.01	0.01	0.00	0.77	16.05	0.00	0.02	0.55	0.15	0.83	0.00	101.00	100.60
98SI-03	D899	2	K-feldspar	64.09	0.00	18.02	0.01	0.05	0.00	0.00	0.02	0.56	16.79	0.00	0.04	0.54	0.14	0.09	0.02	100.23	99.63
98SI-03	D899	3	K-feldspar	64.34	0.01	18.16	0.00	0.05	0.00	0.00	0.00	1.63	15.11	0.00	0.00	0.58	0.18	0.13	0.00	100.01	99.61
98SI-03	D899	4	altered biotite	34.24	3.11	13.41	0.00	23.29	0.91	5.19	0.00	0.08	9.63	0.01	0.04	0.35	0.14	0.33	0.76	91.36	91.15
98SI-03	D899	4	altered biotite	34.59	3.21	13.13	0.01	23.01	0.80	5.13	0.01	0.07	9.44	0.01	0.05	0.32	0.14	0.18	0.62	90.58	90.37
98SI-03	D899	4	altered biotite	40.33	2.95	14.79	0.01	17.51	0.49	4.25	0.55	0.08	6.70	0.03	0.21	0.26	0.01	0.07	0.60	88.43	88.18
98SI-03	D899	5	altered biotite	36.30	2.72	13.51	0.00	19.79	0.54	4.93	0.25	0.07	7.96	0.00	0.36	0.30	0.07	0.02	0.50	87.04	87.27
98SI-03	D899	5	altered biotite	43.97	1.73	16.56	0.00	13.60	0.28	3.26	1.73	0.22	4.86	0.08	0.11	0.35	0.08	0.05	0.18	86.99	86.72
98SI-03	D899	6	altered biotite	42.64	1.76	17.04	0.02	13.52	0.28	3.71	1.15	0.21	5.57	0.14	0.11	0.28	0.02	0.03	0.24	86.74	86.48
98SI-03	D899	6	K-feldspar	64.06	0.01	18.01	0.00	0.04	0.00	0.00	0.00	0.30	16.96	0.05	0.12	0.54	0.14	0.03	0.00	100.14	99.74
98SI-03	D899	7	K-feldspar	64.67	0.01	18.18	0.00	0.20	0.00	0.02	0.00	1.53	15.32	0.00	0.06	0.52	0.12	0.06	0.00	100.58	100.18
98SI-03	D899	7	matrix clay	46.15	0.08	22.66	0.00	9.44	0.20	2.21	1.26	1.26	2.66	0.07	0.01	0.38	0.09	0.01	0.08	85.47	85.18
98SI-03	D899	7	matrix clay	52.55	0.69	17.10	0.02	9.25	0.00	1.66	4.29	0.43	1.08	0.08	0.05	0.34	0.01	0.03	0.15	87.72	87.39
98SI-03	D899	8	biotite altered to clay	51.21	0.37	23.86	0.00	7.48	0.10	1.64	2.51	0.18	1.54	0.02	0.02	0.33	0.01	0.00	0.06	89.32	89.00
98SI-03	D899	9	plagioclase	68.32	0.00	21.79	0.03	0.07	0.00	0.00	2.20	7.52	0.42	0.00	0.04	0.43	0.01	0.00	0.00	100.84	100.42
98SI-03	D899	10	K-feldspar	64.41	0.02	18.45	0.00	0.09	0.00	0.00	0.02	1.94	14.62	0.00	0.10	0.58	0.18	0.06	0.05	100.34	99.94
98SI-03	D899	11	matrix clay	50.23	0.56	14.61	0.01	10.86	0.07	1.90	3.18	0.64	1.76	0.09	1.00	0.30	0.00	0.00	0.14	84.36	84.06
98SI-03	D899	12	matrix clay	51.59	1.02	16.14	0.04	9.29	0.00	1.71	2.72	0.41	1.84	0.05	0.03	0.29	0.00	0.00	0.06	85.19	84.90
98SI-03	D899	13	matrix clay	50.69	0.50	14.88	0.02	10.39	0.00	1.72	2.60	0.46	1.94	0.05	0.00	0.35	0.04	0.00	0.13	83.72	83.41
98SI-03	D899	14	altered biotite	48.25	0.71	23.49	0.00	9.35	0.14	1.89	2.16	0.18	2.26	0.00	0.00	0.30	0.02	0.00	0.17	88.91	88.61
98SI-03	D899	15	altered biotite	49.54	0.26	26.98	0.00	7.26	0.01	1.23	1.71	0.11	0.77	0.05	0.01	0.30	0.00	0.00	0.02	88.25	87.95
98SI-03	D899	16	matrix clay	52.54	0.21	16.77	0.01	13.65	0.00	1.58	3.62	0.40	1.52	0.08	0.00	0.36	0.03	0.00	0.02	90.78	90.45
98SI-03	D899	17	biotite altered to ?kaolinite	48.34	0.09	32.14	0.00	4.83	0.02	0.62	1.05	0.17	0.94	0.06	0.05	0.25	0.00	0.00	0.12	88.68	88.43
98SI-03	D899	18	K-feldspar	64.06	0.01	18.42	0.04	0.09	0.00	0.00	0.00	1.22	15.78	0.03	0.07	0.54	0.14	0.28	0.00	100.52	100.12
98SI-03	D899	19	matrix clay	50.26	0.53	14.11	0.05	15.84	0.07	1.45	3.67	0.42	1.38	0.00	0.01	0.32	0.01	0.01	0.04	87.85	87.55
98SI-03	D899	20	matrix clay	50.32	0.54	16.55	0.04	12.39	0.00	1.53	3.24	0.32	1.05	0.03	0.00	0.28	0.00	0.00	0.08	86.37	86.09
98SI-03	D899	21	altered biotite	44.52	1.32	18.87	0.01	16.86	0.34	2.65	1.63	0.18	3.87	0.01	0.12	0.32	0.04	0.04	0.17	90.91	90.63
98SI-03	D899	21	matrix clay	49.73	0.55	15.23	0.01	13.46	0.06	1.68	3.69	0.47	1.23	0.11	0.00	0.29	0.00	0.02	0.12	86.34	86.34
98SI-03	D899	22	altered biotite	42.12	2.42	13.95	0.01	22.13	0.43	4.74	0.73	0.09	5.74	0.15	0.28	0.26	0.00	0.01	0.35	93.42	93.16
98SI-03	D899	23	plagioclase	69.03	0.01	19.40	0.03	0.03	0.01	0.00	0.01	11.73	0.08	0.02	0.00	0.39	0.00	0.01	0.00	100.75	100.36
98SI-03	D899	23	K-feldspar	65.95	0.00	19.39	0.02	0.05	0.00	0.00	0.85	5.39	9.79	0.04	0.08	0.50	0.09	0.15	0.07	102.27	101.86
98SI-03	D903	1	calcite vein	0.07	0.01	0.01	0.01	0.18	1.86	0.06	54.47	0.02	0.00	0.05	0.00	0.03	0.03	0.02	0.01	56.80	56.80
98SI-03	D903	1	calcite vein	0.02	0.00	0.05	0.00	0.20	1.75	0.09	54.03	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.03	56.24	56.24
98SI-03	D903	1	calcite vein	0.02	0.01	0.02	0.02	0.01	0.74	0.04	54.63	0.05	0.00	0.05	0.00	0.00	0.00	0.04	0.05	55.69	55.69
98SI-03	D903	1	calcite vein	0.03	0.00	0.00	0.00	0.20	1.70	0.08	54.21	0.00	0.00	0.02	0.00	0.03	0.03	0.00	0.12	56.41	56.41
98SI-03	D903	1	calcite vein	0.04	0.00	0.00	0.00	0.18	1.76	0.09	54.09	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.05	56.26	56.26
98SI-03	D903	1	calcite vein	0.08	0.00	0.00	0.00	0.22	1.83	0.09	53.37	0.00	0.00	0.04	0.00	0.00	0.00	0.06	0.00	55.68	55.68
98SI-03	D903	unknown	?zeolite	50.23	0.11	22.81	0.01	1.20	0.01	0.14	9.10	4.26	0.43	0.08	0.00	0.37	0.06	0.04	0.04	88.55	88.54
98SI-03	D903	2	calcite vein	0.03	0.00	0.00	0.00	0.14	1.89	0.06	54.22	0.02	0.01	0.08	0.00	0.03	0.03	0.00	0.08	56.55	56.55
98SI-03	D903	2	calcite vein	0.04	0.02	0.00	0.01	0.20	1.74	0.05	54.60	0.09	0.01	0.03	0.00	0.00	0.00	0.00	0.00	56.79	56.79
98SI-03	D903	2	?zeolite	48.89	0.10	23.37	0.01	0.91	0.04	0.11	10.64	4.02	0.28	0.03	0.00	0.44	0.14	0.02	0.02	88.89	88.59
98SI-03	D903	2	?zeolite/feldspar	55.16	0.08	25.60	0.03	1.31	0.00	0.25	9.67	4.57	0.37	0.03	0.00	0.40	0.10	0.09	0.00	97.26	97.26
98SI-03	D903	2	?zeolite/feldspar	51.65	0.11	25.46	0.00	1.30	0.00	0.14	10.99	4.39	0.38	0.03	0.00	0.40	0.08	0.02	0.03	94.58	94.58
98SI-03	D903	3	calcite vein	0.05	0.00	0.01	0.00	0.14	1.02	0.02	53.62	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.05	54.95	54.95
98SI-03	D903	3	calcite vein	0.06	0.01	0.00	0.00	0.12	0.77	0.01	55.23	0.00	0.00	0.05	0.00	0.02	0.02	0.01	0.05	56.34	56.34

Table 2: Microprobe Analyses

Borehole	Sample code	Location	Mineral	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Rb2O	SrO (measured)	SrO (corrected)	BaO	F	Total (measured)	total (corrected)
98SI-03	D903	4	calcite vein	0.06	0.00	0.04	0.01	0.05	0.72	0.05	55.43	0.00	0.00	0.01	0.00	0.06	0.06	0.03	0.05	56.50	56.50
98SI-03	D903	unknown	?zeolite	49.83	0.09	24.91	0.00	1.06	0.00	0.13	11.37	4.46	0.32	0.00	0.01	0.44	0.13	0.09	0.00	92.71	92.40
98SI-03	D903	unknown	?zeolite	51.18	0.10	23.89	0.00	1.35	0.03	0.17	9.90	4.13	1.01	0.05	0.00	0.44	0.12	0.06	0.00	92.31	91.99
98SI-03	D902.1	1	feldspar clast	63.94	0.02	18.27	0.03	0.09	0.00	0.01	0.02	1.06	15.34	0.02	0.01	0.53	0.13	0.14	0.00	99.48	99.08
98SI-03	D902.1	1	feldspar clast	63.37	0.00	17.78	0.00	0.06	0.00	0.01	0.30	1.77	14.83	0.01	0.11	0.50	0.11	0.05	0.31	98.70	98.70
98SI-03	D902.1	1	feldspar clast	66.84	0.02	19.05	0.03	0.07	0.01	0.02	0.04	4.43	11.20	0.00	0.04	0.53	0.12	0.05	0.08	102.43	102.02
98SI-03	D902.1	1	calcite, 'fibrous' vein	0.69	0.01	0.31	0.00	0.22	0.08	0.07	54.54	0.02	0.01	0.03	0.00	0.02	0.02	0.03	0.00	56.02	56.02
98SI-03	D902.1	1	calcite, 'fibrous' vein	1.74	0.03	0.62	0.06	0.17	0.08	0.14	53.11	0.06	0.03	0.04	0.00	0.00	0.00	0.00	0.11	56.19	56.19
98SI-03	D902.1	1	calcite, 'fibrous' vein	0.75	0.00	0.66	0.00	0.06	0.07	0.04	53.41	0.05	0.02	0.03	0.00	0.00	0.00	0.00	0.07	55.18	55.18
98SI-03	D902.1	1	calcite, nodular in vein	19.40	0.19	6.69	0.00	1.30	0.03	1.34	24.21	0.25	0.29	0.08	0.00	0.12	0.00	0.01	0.07	53.99	53.87
98SI-03	D902.1	1	calcite, nodular in vein	1.38	0.04	0.52	0.00	0.15	0.01	0.14	54.28	0.07	0.02	0.03	0.00	0.00	0.00	0.00	0.00	56.64	56.64
98SI-03	D902.1	1	calcite, nodular in vein	3.50	0.03	1.39	0.00	0.25	0.10	0.27	49.88	0.07	0.08	0.04	0.02	0.08	0.06	0.00	0.08	55.80	55.78
98SI-03	D902.1	1	calcite, nodular in vein	1.28	0.00	0.56	0.02	0.12	0.05	0.12	53.67	0.01	0.02	0.03	0.00	0.00	0.00	0.02	0.10	55.99	55.99
98SI-03	D902.1	1	calcite, nodular in vein	48.92	0.65	15.63	0.01	4.54	0.03	2.64	4.45	0.39	1.78	0.13	0.01	0.37	0.07	0.04	0.09	79.70	79.40
98SI-03	D902.1	2	sheared clay	62.52	0.01	17.63	0.00	0.16	0.01	0.08	0.34	3.79	10.51	0.01	0.03	0.46	0.07	0.01	0.04	95.61	95.22
98SI-03	D902.1	2	feldspar clast	62.33	0.03	17.38	0.00	0.20	0.00	0.15	0.33	1.70	13.90	0.00	0.01	0.54	0.15	0.03	0.00	96.20	96.20
98SI-03	D902.1	2	calcite, 'fibrous' vein	1.60	0.03	0.74	0.05	0.37	0.60	0.22	52.39	0.04	0.04	0.04	0.01	0.00	0.00	0.00	0.09	96.59	96.59
98SI-03	D902.1	2	calcite, 'fibrous' vein	2.07	0.01	0.75	0.00	0.30	0.02	0.20	52.36	0.08	0.11	0.06	0.02	0.00	0.00	0.00	0.03	56.01	56.01
98SI-03	D902.1	2	calcite, 'fibrous' vein	2.27	0.03	0.69	0.01	0.33	0.05	0.23	52.03	0.01	0.05	0.05	0.06	0.00	0.00	0.00	0.10	56.09	56.09
98SI-03	D902.1	2	calcite, 'fibrous' vein	40.41	0.73	25.71	0.00	5.78	0.01	2.85	2.79	0.36	0.74	0.03	0.01	0.25	0.00	0.03	0.22	79.90	79.90
98SI-03	D902.1	2	sheared clay	51.01	2.17	16.48	0.01	5.34	0.05	2.63	3.35	0.64	3.45	0.08	0.02	0.35	0.03	0.07	0.15	85.47	85.47
98SI-03	D902.1	2	sheared clay	50.83	0.84	17.46	0.01	8.33	0.07	2.27	3.04	0.90	1.30	0.32	0.00	0.36	0.04	0.05	0.25	86.04	86.72
98SI-03	D902.1	3	sheared clay	49.63	0.82	13.70	0.00	6.40	0.02	2.25	3.27	1.69	1.24	0.13	0.00	0.29	0.00	0.02	0.18	79.84	79.35
98SI-03	D902.1	4	calcite, 'fibrous' vein	0.30	0.01	0.21	0.00	0.05	0.10	0.03	54.27	0.00	0.00	0.09	0.03	0.01	0.01	0.02	0.06	55.18	55.18
98SI-03	D902.1	4	calcite, 'fibrous' vein	0.54	0.02	0.25	0.02	0.11	0.08	0.03	54.52	0.08	0.01	0.03	0.00	0.04	0.04	0.02	0.02	55.77	55.77
98SI-03	D902.1	4	calcite, 'fibrous' vein	1.45	0.02	0.60	0.00	0.20	0.11	0.10	52.91	0.03	0.02	0.06	0.00	0.00	0.00	0.02	0.00	55.51	55.51
98SI-03	D902.1	4	calcite, nodular in vein	1.41	0.02	0.55	0.00	0.17	0.10	0.12	51.00	0.03	0.06	0.07	0.00	0.02	0.01	0.01	0.00	53.57	53.56
98SI-03	D902.1	4	calcite, nodular in vein	1.40	0.01	0.55	0.00	0.16	0.06	0.10	53.56	0.03	0.02	0.08	0.03	0.03	0.02	0.00	0.00	56.03	56.02
98SI-03	D902.1	4	calcite, nodular in vein	0.72	0.00	0.34	0.00	0.08	0.04	0.07	54.34	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.04	55.67	55.67
98SI-03	D902.1	5	feldspar clast	60.08	0.01	17.94	0.01	0.16	0.00	0.01	0.13	0.70	15.49	0.02	0.00	0.52	0.15	0.32	0.07	95.46	95.09
98FE-01	F522	1	altered biotite	35.02	2.07	13.46	0.01	27.63	0.54	6.31	0.33	0.15	3.45	0.00	0.04	0.30	0.08	0.07	0.13	89.50	89.28
98FE-01	F522	2	altered biotite	36.71	2.94	13.17	0.00	26.13	0.81	5.38	0.23	0.16	1.69	0.00	0.01	0.25	0.11	0.06	0.01	87.56	87.33
98FE-01	F522	3	altered biotite	35.28	2.82	13.21	0.02	26.57	0.91	5.33	0.23	0.06	7.85	0.00	0.04	0.33	0.11	0.06	0.59	93.30	93.08
98FE-01	F522	3	altered biotite	32.98	2.98	13.14	0.00	27.41	0.99	5.33	0.10	0.11	8.31	0.00	0.04	0.24	0.04	0.18	0.59	92.40	92.20
98FE-01	F522	4	altered biotite	35.90	3.29	13.00	0.04	27.30	0.97	5.14	0.24	0.10	7.61	0.00	0.02	0.30	0.08	0.24	0.34	94.50	94.28
98FE-01	F522	5	altered biotite	34.88	3.33	12.68	0.02	27.14	0.81	5.36	0.27	0.14	6.63	0.00	0.02	0.28	0.06	0.06	0.31	91.94	91.72
98FE-01	F522	6	altered biotite	36.00	2.38	13.50	0.00	27.27	0.82	5.67	0.19	0.07	7.69	0.00	0.06	0.35	0.13	0.00	0.43	94.43	94.21
98FE-01	F522	7	altered biotite	35.81	3.18	13.19	0.00	25.94	0.85	5.16	0.41	0.13	6.49	0.00	0.01	0.29	0.07	0.15	0.53	92.14	91.92
98FE-01	F522	8	K-feldspar	64.26	0.01	18.02	0.01	0.11	0.00	0.00	0.00	0.50	16.51	0.00	0.05	0.59	0.19	0.17	0.10	100.34	99.94
98FE-01	F522	9	K-feldspar	64.87	0.02	18.45	0.00	0.06	0.00	0.00	0.00	0.70	16.44	0.00	0.06	0.53	0.13	0.01	0.00	101.14	100.74
98FE-01	F522	8	K-feldspar	63.23	0.00	18.14	0.00	0.06	0.00	0.00	0.01	0.79	16.30	0.00	0.01	0.52	0.13	0.06	0.00	99.12	98.73
98FE-01	F522	8	K-feldspar	63.27	0.04	17.96	0.01	0.09	0.02	0.02	0.00	0.42	16.61	0.00	0.07	0.53	0.14	0.33	0.08	99.45	99.06
98FE-01	F522	8	K-feldspar	65.19	0.02	18.16	0.00	0.10	0.00	0.01	0.04	1.23	15.68	0.00	0.00	0.53	0.13	0.08	0.00	101.05	100.65
98FE-01	F522	10	K-feldspar	64.48	0.02	18.19	0.00	0.07	0.02	0.00	0.00	0.80	16.41	0.00	0.03	0.59	0.19	0.05	0.00	100.66	100.26

Table 2: Microprobe Analyses

Borehole	Sample code	Location	Mineral	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Rb2O	SrO (measured)	SrO (corrected)	BaO	F	Total (measured)	total (corrected)
98FE-01	F522	11	K-feldspar	63.46	0.04	18.39	0.00	0.08	0.00	0.00	0.05	1.56	14.61	0.00	0.06	0.53	0.14	1.20	0.00	99.99	99.80
98FE-01	F522	12	K-feldspar	65.07	0.00	18.33	0.00	0.09	0.02	0.00	0.03	0.63	16.52	0.00	0.12	0.51	0.11	0.03	0.00	101.35	100.95
98FE-01	F522	13	K-feldspar	63.99	0.02	18.01	0.00	0.10	0.02	0.00	0.02	0.49	16.89	0.00	0.04	0.51	0.11	0.10	0.00	100.19	99.79
98FE-01	F522	14	K-feldspar	65.02	0.03	18.31	0.00	0.05	0.00	0.01	0.00	0.84	16.21	0.00	0.08	0.54	0.14	0.12	0.01	101.22	100.82
98FE-01	F522	15	plagioclase	63.94	0.00	21.55	0.04	0.19	0.00	0.00	3.00	9.88	0.40	0.03	0.03	0.42	0.02	0.00	0.00	99.47	99.07
98FE-01	F522	15	plagioclase	65.38	0.03	23.88	0.00	0.14	0.00	0.01	4.70	6.47	0.34	0.07	0.00	0.46	0.05	0.02	0.02	101.51	101.10
98FE-01	F522	16	altered plagioclase	73.67	0.02	20.74	0.00	0.07	0.00	0.00	0.46	7.37	0.16	0.00	0.03	0.42	0.00	0.01	0.01	102.98	102.56
98FE-01	F522	17	altered plagioclase	59.63	0.02	20.95	0.00	0.80	0.02	0.25	3.19	9.07	0.38	0.00	0.02	0.38	0.01	0.00	0.00	94.62	94.25
98FE-01	F522	18	chirote?	37.91	1.66	14.47	0.00	25.36	0.45	4.97	0.69	0.16	4.56	0.01	0.00	0.31	0.07	0.02	0.21	90.78	90.54
98FE-01	F522	19	chirote?	35.68	0.23	15.29	0.00	30.20	0.51	4.93	0.77	0.20	3.77	0.00	0.01	0.24	0.02	0.00	0.09	91.82	91.60
98FE-01	F522	20	muscovite?	45.00	0.18	32.05	0.00	4.37	0.18	0.36	0.06	0.48	10.64	0.00	0.07	0.29	0.01	0.24	0.22	94.15	93.87
98FE-01	F522	21	muscovite?	48.90	0.10	33.37	0.00	6.09	0.17	1.28	0.00	0.19	10.99	0.00	0.08	0.32	0.02	0.15	0.23	101.87	101.57
98FE-01	F522	22	plagioclase	100.78	0.00	0.02	0.01	0.03	0.01	0.00	0.00	0.02	0.01	0.00	0.02	0.61	0.00	0.00	0.07	101.57	100.96
98FE-01	F522	23	chirote?	36.14	1.73	13.57	0.00	25.58	0.51	5.57	0.44	0.12	5.74	0.01	0.12	0.22	0.00	0.07	0.37	90.17	89.95
98FE-01	F522	23	chirote?	35.23	0.76	13.74	0.02	28.78	0.45	4.98	0.71	0.19	3.08	0.01	0.06	0.29	0.07	0.02	0.11	88.43	88.21
TH-2	F547	1	calcite, fibrous vein rim	0.24	0.03	0.05	0.01	0.97	2.15	0.03	54.01	0.05	0.00	0.05	0.00	0.00	0.00	0.05	0.06	57.71	57.71
TH-2	F547	1	calcite, fibrous vein rim	0.06	0.00	0.02	0.00	0.70	3.07	0.01	52.24	0.01	0.00	0.05	0.00	0.03	0.03	0.01	0.04	56.24	56.24
TH-2	F547	1	calcite, fibrous vein rim	0.77	0.00	0.24	0.00	1.39	1.59	0.06	51.58	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.01	55.70	55.70
TH-2	F547	1	calcite, vein core	0.17	0.00	0.02	0.01	0.22	2.43	0.03	54.45	0.01	0.00	0.02	0.00	0.01	0.01	0.00	0.06	57.43	57.43
TH-2	F547	1	calcite, vein core	0.03	0.00	0.00	0.02	0.30	2.05	0.01	54.60	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.08	57.15	57.15
TH-2	F547	1	calcite, vein core	0.04	0.00	0.00	0.01	0.15	1.55	0.02	54.87	0.04	0.00	0.03	0.00	0.03	0.03	0.00	0.17	56.91	56.91
TH-2	F547	1	calcite, fibrous vein rim	0.52	0.00	0.09	0.00	0.31	1.47	0.03	54.15	0.01	0.00	0.01	0.00	0.10	0.10	0.01	0.00	56.70	56.70
TH-2	F547	1	calcite, fibrous vein rim	0.39	0.00	0.08	0.00	0.80	2.31	0.05	52.96	0.04	0.00	0.00	0.03	0.04	0.04	0.00	0.00	56.71	56.71
TH-2	F547	1	calcite, fibrous vein rim	0.33	0.00	0.07	0.00	0.44	2.18	0.03	53.16	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	56.26	56.26
TH-2	F547	1	calcite, thin x-cutting vein	0.06	0.00	0.02	0.00	0.13	1.91	0.03	55.73	0.04	0.00	0.03	0.00	0.05	0.05	0.00	0.07	58.05	58.05
TH-2	F547	1	calcite, thin x-cutting vein	0.04	0.00	0.04	0.00	0.15	1.90	0.03	55.29	0.03	0.00	0.04	0.02	0.00	0.00	0.00	0.00	57.55	57.55
TH-2	F547	2	calcite, fibrous vein rim	0.26	0.02	0.05	0.00	0.53	1.53	0.04	54.95	0.00	0.01	0.04	0.05	0.00	0.00	0.00	0.02	57.52	57.52
TH-2	F547	2	calcite, fibrous vein rim	0.48	0.00	0.13	0.00	0.71	1.44	0.06	52.79	0.04	0.01	0.00	0.03	0.00	0.00	0.00	0.03	55.72	55.72
TH-2	F547	2	calcite, vein core	0.22	0.00	0.06	0.00	0.56	1.77	0.01	54.82	0.02	0.01	0.03	0.00	0.00	0.00	0.04	0.00	57.53	57.53
TH-2	F547	2	calcite, vein core	0.04	0.00	0.00	0.00	0.22	1.47	0.00	56.13	0.02	0.01	0.04	0.00	0.00	0.00	0.01	0.18	58.12	58.12
TH-2	F547	3	calcite, fibrous vein rim	0.18	0.00	0.05	0.02	0.75	2.13	0.02	52.47	0.03	0.01	0.02	0.01	0.00	0.00	0.00	0.01	55.71	55.71
TH-2	F547	3	calcite, fibrous vein rim	0.24	0.00	0.06	0.01	0.35	3.42	0.02	51.90	0.06	0.01	0.04	0.04	0.01	0.01	0.03	0.03	56.21	56.21
TH-2	F547	3	calcite, vein core	0.30	0.03	0.05	0.00	0.29	1.67	0.00	54.22	0.00	0.00	0.07	0.00	0.04	0.04	0.04	0.02	56.72	56.72
TH-2	F547	3	calcite, vein core	0.49	0.02	0.10	0.03	0.41	1.55	0.05	52.81	0.01	0.00	0.04	0.01	0.01	0.01	0.06	0.06	55.65	55.65
TH-2	F547	4	epidote	37.51	0.05	24.98	0.00	10.40	0.52	0.08	22.65	0.06	0.00	0.05	0.02	0.59	0.35	0.00	0.09	96.96	96.76
TH-2	F547	4	epidote	37.27	0.44	22.65	0.03	12.90	0.05	0.13	23.76	0.02	0.00	0.01	0.00	0.29	0.06	0.05	0.06	97.43	97.43
TH-2	F547	4	epidote	37.69	0.05	24.45	0.00	10.62	0.12	0.04	23.92	0.03	0.00	0.00	0.02	0.43	0.20	0.03	0.05	97.44	97.21
TH-2	F547	5	epidote	37.48	0.17	23.77	0.00	11.25	0.23	0.04	23.33	0.05	0.01	0.07	0.00	0.48	0.25	0.00	0.09	96.96	96.73
TH-2	F547	5	epidote	37.11	0.37	22.01	0.01	13.30	0.07	0.10	23.59	0.05	0.02	0.01	0.00	0.30	0.12	0.02	0.01	96.99	96.76
TH-2	F547	5	epidote	37.75	0.03	23.72	0.01	11.62	0.08	0.02	23.89	0.00	0.00	0.01	0.01	0.35	0.17	0.08	0.08	97.60	97.37
TH-2	F547	6	epidote	37.21	0.10	25.00	0.02	10.24	0.59	0.07	22.55	0.01	0.01	0.08	0.00	0.75	0.52	0.03	0.00	96.64	96.41
TH-2	F547	7	matrix chlorite	37.88	0.31	22.26	0.04	12.68	0.21	0.05	23.36	0.04	0.00	0.05	0.02	0.43	0.20	0.01	0.00	97.15	96.92
TH-2	F547	7	matrix chlorite	32.71	0.05	15.22	0.02	22.33	0.56	15.47	0.64	0.14	0.04	0.00	0.00	0.19	0.00	0.00	0.16	87.53	87.34
TH-2	F547	8	calcite, vein core	34.32	0.04	14.50	0.02	21.78	0.49	12.50	0.65	0.17	0.07	0.00	0.01	0.20	0.00	0.00	0.17	84.92	84.72
TH-2	F547	8	calcite, vein core	0.03	0.00	0.00	0.01	0.11	2.10	0.00	54.17	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.02	56.49	56.49
TH-2	F547	8	calcite, vein core	0.02	0.00	0.02	0.01	0.10	1.78	0.03	53.92	0.06	0.01	0.01	0.00	0.03	0.03	0.03	0.02	56.05	56.05

Table 2: Microprobe Analyses

Borehole	Sample code	Location	Mineral	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Rb2O	SrO (measured)	SrO (corrected)	BaO	F	Total (measured)	total (corrected)
TH-2	F547	8	calcite, vein core	0.02	0.02	0.03	0.03	0.12	2.00	0.01	54.28	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06	56.60	56.60
TH-2	F547	8	calcite, vein core	0.00	0.00	0.03	0.00	0.14	1.56	0.00	54.64	0.04	0.00	0.00	0.07	0.00	0.00	0.00	0.07	56.54	56.54
MIU-2	F558	1.1	plagioclase	68.14	0.01	21.68	0.00	0.11	0.03	0.00	2.43	7.05	0.31	0.00	0.00	0.42	0.00	0.00	0.03	100.21	99.79
MIU-2	F558	1.2	altered K-feldspar	62.36	0.01	17.69	0.00	0.09	0.00	0.01	0.00	0.50	16.71	0.01	0.03	0.54	0.16	0.05	0.04	98.05	97.86
MIU-2	F558	1.3	altered K-feldspar	63.39	0.00	17.81	0.00	0.05	0.00	0.01	0.00	0.37	17.11	0.00	0.06	0.56	0.16	0.00	0.00	99.35	98.96
MIU-2	F558	1.4	altered K-feldspar	61.94	0.02	17.75	0.01	0.06	0.01	0.00	0.00	0.76	16.34	0.00	0.11	0.61	0.22	0.00	0.07	97.67	97.28
MIU-2	F558	1.5	calcite	0.03	0.00	0.02	0.03	0.00	0.00	0.00	57.23	0.02	0.00	n.d.	0.01	0.01	0.01	0.03	0.00	57.39	57.39
MIU-2	F558	1.6	calcite	0.01	0.00	0.00	0.00	0.00	0.00	0.00	56.93	0.00	0.00	n.d.	0.01	0.00	0.00	0.01	0.00	56.97	56.97
MIU-2	F558	1.7	calcite	0.11	0.00	0.03	0.03	0.00	0.06	0.00	56.78	0.03	0.01	n.d.	0.01	0.02	0.02	0.00	0.00	57.07	57.07
MIU-2	F558	1.8	altered K-feldspar	61.51	0.00	17.80	0.00	0.13	0.00	0.01	0.00	0.80	16.91	0.02	0.09	0.54	0.16	0.05	0.01	97.62	97.24
MIU-2	F558	1.9	chlorite after biotite	29.31	2.13	15.66	0.00	32.47	2.44	3.73	0.29	0.06	4.00	0.03	0.09	0.21	0.02	0.05	0.42	90.91	90.73
MIU-2	F558	1.9	chlorite after biotite	29.52	2.22	15.72	0.01	32.14	1.94	3.40	0.18	0.06	4.73	0.00	0.05	0.15	0.00	0.26	0.34	90.71	90.56
MIU-2	F558	2.1	plagioclase	67.11	0.02	22.04	0.00	0.12	0.00	0.00	3.14	6.36	0.22	0.03	0.01	0.38	0.00	0.03	0.00	99.46	99.08
MIU-2	F558	2.2	K-feldspar	65.12	0.01	18.22	0.03	0.09	0.00	0.00	1.43	15.50	0.00	0.07	0.01	0.49	0.08	0.00	0.03	100.96	100.56
MIU-2	F558	2.3	plagioclase	70.98	0.02	21.59	0.00	0.09	0.00	0.00	1.80	4.90	0.27	0.01	0.01	0.45	0.00	0.00	0.00	100.12	99.68
MIU-2	F558	2.4	calcite	0.02	0.00	0.01	0.00	0.00	0.04	0.00	56.90	0.05	0.00	n.d.	0.03	0.04	0.04	0.04	0.01	57.14	57.14
MIU-2	F558	2.5	calcite	0.04	0.00	0.00	0.00	0.02	0.01	0.00	57.04	0.02	0.00	n.d.	0.00	0.00	0.00	0.00	0.00	57.14	57.14
MIU-2	F558	2.6	calcite	0.07	0.00	0.00	0.00	0.03	0.01	0.00	57.01	0.03	0.00	n.d.	0.00	0.00	0.00	0.01	0.00	57.17	57.17
MIU-2	F558	2.7	calcite	0.06	0.01	0.03	0.00	0.00	0.00	0.01	56.79	0.00	0.00	n.d.	0.00	0.03	0.03	0.03	0.02	57.09	57.09
MIU-2	F558	2.8	calcite	0.06	0.01	0.03	0.00	0.02	0.01	0.01	56.59	0.00	0.00	n.d.	0.02	0.00	0.00	0.00	0.06	56.73	56.73
MIU-2	F558	3.1	calcite	0.00	0.00	0.02	0.00	0.00	0.01	0.00	56.85	0.03	0.00	n.d.	0.00	0.00	0.00	0.00	0.00	56.81	56.81
MIU-2	F558	3.2	calcite	0.04	0.00	0.01	0.03	0.02	0.00	0.00	56.70	0.00	0.00	n.d.	0.00	0.00	0.00	0.00	0.04	57.42	57.42
MIU-2	F558	3.3	calcite	0.07	0.00	0.01	0.02	0.03	0.07	0.01	57.14	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.08	57.53	57.53
MIU-2	F558	3.4	calcite	0.06	0.01	0.00	0.00	0.00	0.00	0.00	57.23	0.00	0.00	n.d.	0.03	0.09	0.09	0.02	0.04	57.42	57.42
MIU-2	F558	3.5	calcite	0.01	0.00	0.00	0.03	0.01	0.00	0.01	56.38	0.00	0.00	n.d.	0.02	0.01	0.01	0.00	0.06	56.53	56.53
MIU-2	F558	4.1	plagioclase	65.30	0.02	20.79	0.00	0.08	0.00	0.00	2.26	10.08	0.38	0.01	0.00	0.42	0.02	0.04	0.03	99.40	99.00
MIU-2	F558	4.1	altered plagioclase	64.49	0.00	19.84	0.01	0.00	0.01	0.01	0.64	10.96	0.27	0.00	0.02	0.39	0.00	0.00	0.00	96.66	96.66
MIU-2	F558	4.2	plagioclase	63.83	0.03	21.35	0.02	0.11	0.00	0.01	2.73	10.05	0.42	0.00	0.00	0.39	0.00	0.00	0.00	96.27	96.27
MIU-2	F558	4.3	chlorite? after biotite	28.68	1.92	16.28	0.00	34.01	1.77	3.20	0.55	0.16	2.25	0.00	0.07	0.13	0.00	0.01	0.38	89.42	89.29
MIU-2	F558	4.3	chlorite? after biotite	25.61	1.28	17.53	0.01	36.12	2.30	3.17	0.27	0.07	1.62	0.00	0.04	0.22	0.06	0.00	0.14	88.37	88.21
MIU-2	F558	4.5	chlorite? after biotite	28.46	1.97	15.73	0.01	32.15	1.85	3.25	0.65	0.23	2.40	0.00	0.11	0.18	0.00	0.09	0.05	87.18	87.00
MIU-2	F558	4.6	K-feldspar	64.81	0.00	18.21	0.02	0.07	0.00	0.01	0.00	0.54	16.54	0.00	0.10	0.49	0.14	0.03	0.00	100.84	100.44
MIU-2	F558	4.6	K-feldspar	63.84	0.01	18.13	0.00	0.08	0.00	0.00	0.00	0.66	16.56	0.00	0.09	0.54	0.14	0.03	0.00	99.93	99.53
MIU-2	F558	4.6	plagioclase	69.33	0.00	22.66	0.00	0.10	0.00	0.03	2.81	6.21	0.42	0.00	0.04	0.44	0.01	0.00	0.02	102.06	101.63
MIU-2	F558	4.6	chlorite? after biotite	28.24	0.10	19.58	0.00	36.66	1.59	3.77	0.31	0.16	0.67	0.00	0.04	0.14	0.00	0.04	0.00	91.29	91.15
MIU-2	F558	4.7	chlorite? after biotite	29.82	1.70	16.59	0.00	33.14	1.63	3.06	0.87	0.20	1.45	0.00	0.06	0.18	0.00	0.03	0.28	88.81	88.63
MIU-2	F558	4.7	chlorite? after biotite	29.13	1.75	16.53	0.01	34.48	1.72	2.90	0.88	0.12	0.86	0.00	0.00	0.19	0.01	0.00	0.22	88.81	88.63
MIU-2	F558	4.7	plagioclase	72.32	0.02	21.56	0.00	0.03	0.01	0.00	1.48	5.41	0.06	0.00	0.00	0.44	0.00	0.02	0.06	101.41	100.97
MIU-2	F558	4.7	chlorite? after biotite	28.53	1.43	16.58	0.00	35.28	2.58	3.41	0.82	0.12	0.52	0.00	0.01	0.24	0.06	0.00	0.36	89.88	89.78
MIU-2	F558	4.7	K-feldspar	65.00	0.02	17.96	0.00	0.10	0.00	0.00	0.00	0.72	16.37	0.01	0.01	0.49	0.09	0.00	0.00	100.69	100.29
MIU-2	F558	4.7	chlorite? after biotite	24.75	1.65	15.92	0.01	35.39	5.51	3.43	0.43	0.06	0.36	0.04	0.00	0.16	0.01	0.04	0.33	88.07	87.92
MIU-2	F558	4.8	chlorite? after biotite	28.80	1.70	15.43	0.00	35.12	2.00	2.95	0.49	0.12	2.47	0.03	0.05	0.20	0.02	0.04	0.33	89.73	89.55
MIU-2	F558	4.8	K-feldspar	64.35	0.01	17.92	0.03	0.08	0.00	0.01	0.00	0.45	16.70	0.00	0.10	0.49	0.00	0.00	0.01	100.14	99.74
MIU-2	F558	4.9	K-feldspar	64.33	0.01	18.43	0.03	0.00	0.01	0.03	0.03	0.73	16.37	0.00	0.07	0.63	0.23	0.06	0.00	100.74	100.34
MIU-2	F558	4.9	K-feldspar	64.17	0.01	17.77	0.00	0.05	0.04	0.01	0.01	0.48	16.89	0.00	0.08	0.48	0.08	0.03	0.00	100.03	99.63
MIU-2	F558	4.10	K-feldspar	65.26	0.00	18.26	0.02	0.05	0.01	0.00	0.00	0.88	16.33	0.03	0.09	0.59	0.19	0.00	0.00	101.52	101.12

Table 2: Microprobe Analyses

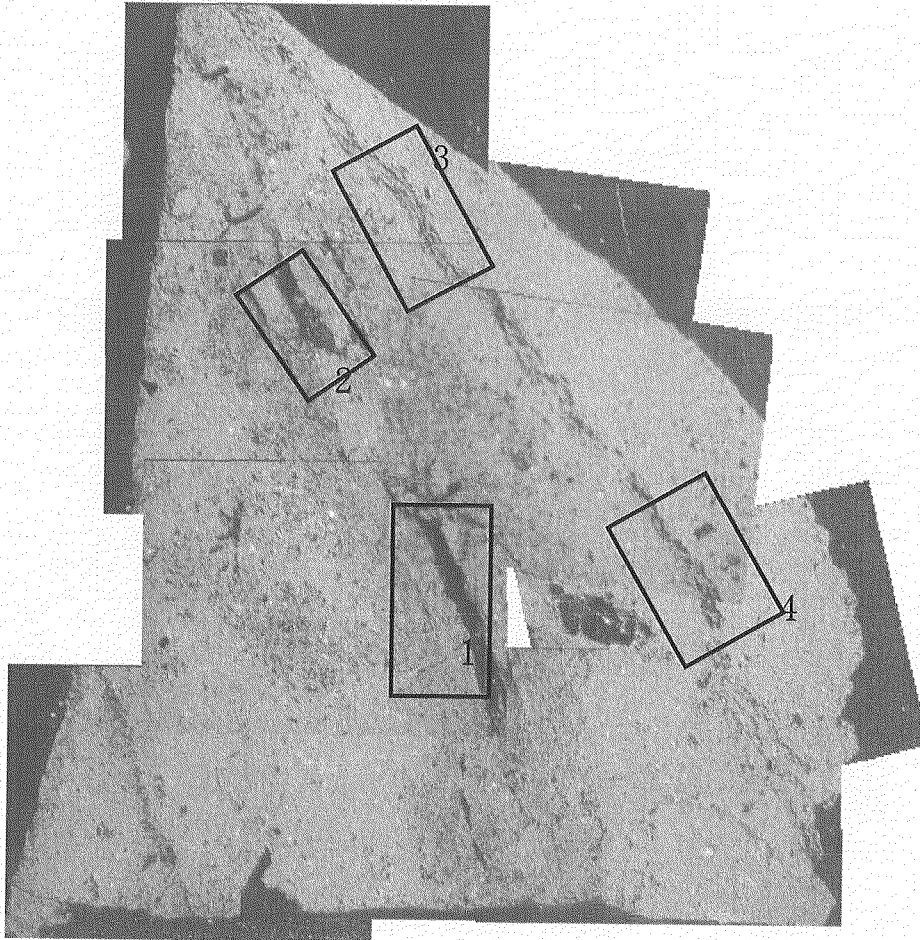
Borehole	Sample code	Location	Mineral	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Rb2O	SrO (measured)	SrO (corrected)	BaO	F	Total (measured)	total (corrected)
MIU-2	F568	4.11	K-feldspar	64.96	0.01	18.42	0.05	0.12	0.02	0.01	0.00	1.40	15.01	0.00	0.02	0.52	0.12	0.02	0.02	100.58	100.18
MIU-2	F568	5.1	plagioclase	68.79	0.00	19.65	0.00	0.10	0.00	0.00	0.59	11.53	0.11	0.00	0.01	0.40	0.00	0.01	0.00	101.19	100.79
MIU-2	F568	5.2	plagioclase	69.87	0.00	22.13	0.00	0.10	0.00	0.00	2.53	4.81	0.11	0.00	0.00	0.36	0.00	0.01	0.00	99.91	99.52
MIU-2	F568	5.3	plagioclase	69.30	0.00	22.20	0.01	0.08	0.02	0.02	2.44	5.68	0.34	0.00	0.00	0.45	0.02	0.02	0.00	100.55	100.12
MIU-2	F568	5.3	plagioclase	68.63	0.00	22.52	0.02	0.08	0.00	0.01	3.01	5.99	0.32	0.00	0.00	0.42	0.00	0.02	0.07	101.09	100.67
TM-2	F534	1	altered biotite	30.50	2.97	13.37	0.00	32.01	0.80	4.91	0.52	0.18	2.52	0.00	0.03	0.24	0.05	0.08	0.31	88.44	88.25
TM-2	F534	2	altered biotite	33.09	3.00	13.36	0.01	29.79	0.64	4.91	0.40	0.17	4.31	0.00	0.06	0.22	0.01	0.04	0.29	90.28	90.07
TM-2	F534	3	altered biotite	30.79	2.82	14.10	0.03	31.47	0.70	5.05	0.61	0.19	2.02	0.01	0.07	0.23	0.04	0.02	0.37	88.47	88.28
TM-2	F534	4	plagioclase	69.73	0.02	22.07	0.01	0.11	0.00	0.00	2.24	7.77	0.37	0.01	0.00	0.39	0.00	0.00	0.05	102.76	102.37
TM-2	F534	4	muscovite	47.16	0.00	38.13	0.01	0.27	0.00	0.02	0.00	0.08	11.54	0.02	0.10	0.46	0.17	0.01	0.00	97.79	97.50
TM-2	F534	5	plagioclase	65.47	0.00	21.88	0.00	0.12	0.01	0.00	3.08	7.11	0.61	0.04	0.02	0.45	0.04	0.06	0.01	98.84	98.43
TM-2	F534	6	plagioclase	62.12	0.03	18.38	0.03	0.14	0.00	0.00	0.03	1.74	15.11	0.00	0.07	0.55	0.16	0.30	0.00	98.50	98.11
TM-2	F534	7	K-feldspar	64.63	0.00	18.11	0.03	0.09	0.01	0.01	0.02	0.59	16.92	0.00	0.09	0.56	0.16	0.20	0.07	100.93	100.53
TM-2	F534	8	altered K-feldspar	61.71	0.00	17.66	0.01	0.06	0.00	0.02	0.00	0.22	16.97	0.00	0.13	0.48	0.10	0.11	0.00	97.37	96.99
TM-2	F534	9	K-feldspar	64.68	0.00	17.99	0.00	0.07	0.00	0.00	0.01	0.65	16.95	0.00	0.09	0.52	0.10	0.01	0.06	100.66	100.26
TM-2	F534	10	altered K-feldspar	67.44	0.01	18.51	0.01	0.06	0.00	0.00	0.02	0.44	16.79	0.00	0.09	0.52	0.10	0.01	0.02	103.90	103.48
TM-2	F534	11	plagioclase	58.57	0.01	25.32	0.01	0.16	0.01	0.00	7.63	7.02	0.26	0.06	0.09	0.46	0.10	0.00	0.02	99.64	99.28
TM-2	F534	11	matrix clay	53.88	0.06	28.20	0.00	1.68	0.02	1.38	1.30	0.19	0.07	0.03	0.00	0.32	0.00	0.01	0.08	87.23	86.91
TM-2	F534	22	matrix clay	54.80	0.06	26.57	0.00	2.10	0.05	1.51	1.45	0.13	0.06	0.00	0.04	0.40	0.06	0.00	0.09	87.05	86.71
TM-2	F534	22	plagioclase	61.34	0.00	24.64	0.00	0.14	0.00	0.00	6.20	7.53	0.35	0.08	0.02	0.47	0.09	0.02	0.01	100.82	100.44
TM-2	F534	12	K-feldspar	47.32	0.02	35.81	0.01	1.40	0.07	0.45	0.03	0.08	10.92	0.00	0.19	0.34	0.05	0.01	0.14	96.79	96.50
TM-2	F534	12	K-feldspar	66.36	0.01	18.46	0.00	0.04	0.01	0.00	0.00	0.34	16.94	0.00	0.15	0.53	0.12	0.06	0.07	102.97	102.56
TM-2	F534	13	altered biotite	39.89	1.83	21.07	0.01	18.97	0.35	2.66	0.54	0.18	2.90	0.02	0.05	0.29	0.04	0.00	0.17	88.94	88.69
TM-2	F534	14	?chlorite	37.42	1.54	23.27	0.00	15.54	0.32	2.62	0.46	0.11	1.67	0.00	0.02	0.20	0.00	0.01	0.10	83.28	83.08
TM-2	F534	15	?mica after feldspar	49.35	0.00	30.96	0.00	5.15	0.07	1.81	0.01	0.08	10.57	0.00	0.25	0.31	0.00	0.01	0.23	98.81	98.50
TM-2	F534	15	?mica after feldspar	48.39	0.17	33.84	0.00	2.57	0.05	0.53	0.05	0.15	9.94	0.00	0.12	0.39	0.09	0.04	0.13	96.98	96.08
TM-2	F534	15	K-feldspar	65.70	0.01	18.68	0.00	0.01	0.00	0.00	0.15	0.42	16.24	0.00	0.12	0.58	0.17	0.20	0.05	102.16	101.75
TM-2	F534	16	plagioclase	66.41	0.01	23.49	0.00	0.05	0.00	0.00	4.12	6.96	0.28	0.00	0.00	0.44	0.03	0.02	0.03	101.82	101.41
TM-2	F534	16	plagioclase	70.22	0.00	20.99	0.02	0.05	0.02	0.00	1.39	8.67	0.15	0.00	0.01	0.45	0.01	0.00	0.05	102.02	101.58
TM-2	F534	17	plagioclase	70.29	0.00	19.82	0.00	0.05	0.01	0.00	0.05	7.81	2.83	0.00	0.00	0.50	0.06	0.05	0.08	101.50	101.06
TM-2	F534	17	?chlorite	38.10	0.06	21.42	0.02	22.11	0.49	3.41	0.62	0.16	2.88	0.00	0.06	0.28	0.04	0.07	0.08	89.75	89.51
TM-2	F534	18	?chlorite	41.72	1.45	26.78	0.00	14.04	0.22	2.57	0.37	0.15	2.59	0.00	0.06	0.27	0.01	0.04	0.16	90.43	90.17
TM-2	F534	19	matrix clay	48.04	0.06	27.42	0.02	2.80	0.04	0.94	0.84	0.34	3.41	0.00	0.08	0.36	0.06	0.01	0.05	84.40	84.10

Appendix Analysis locations

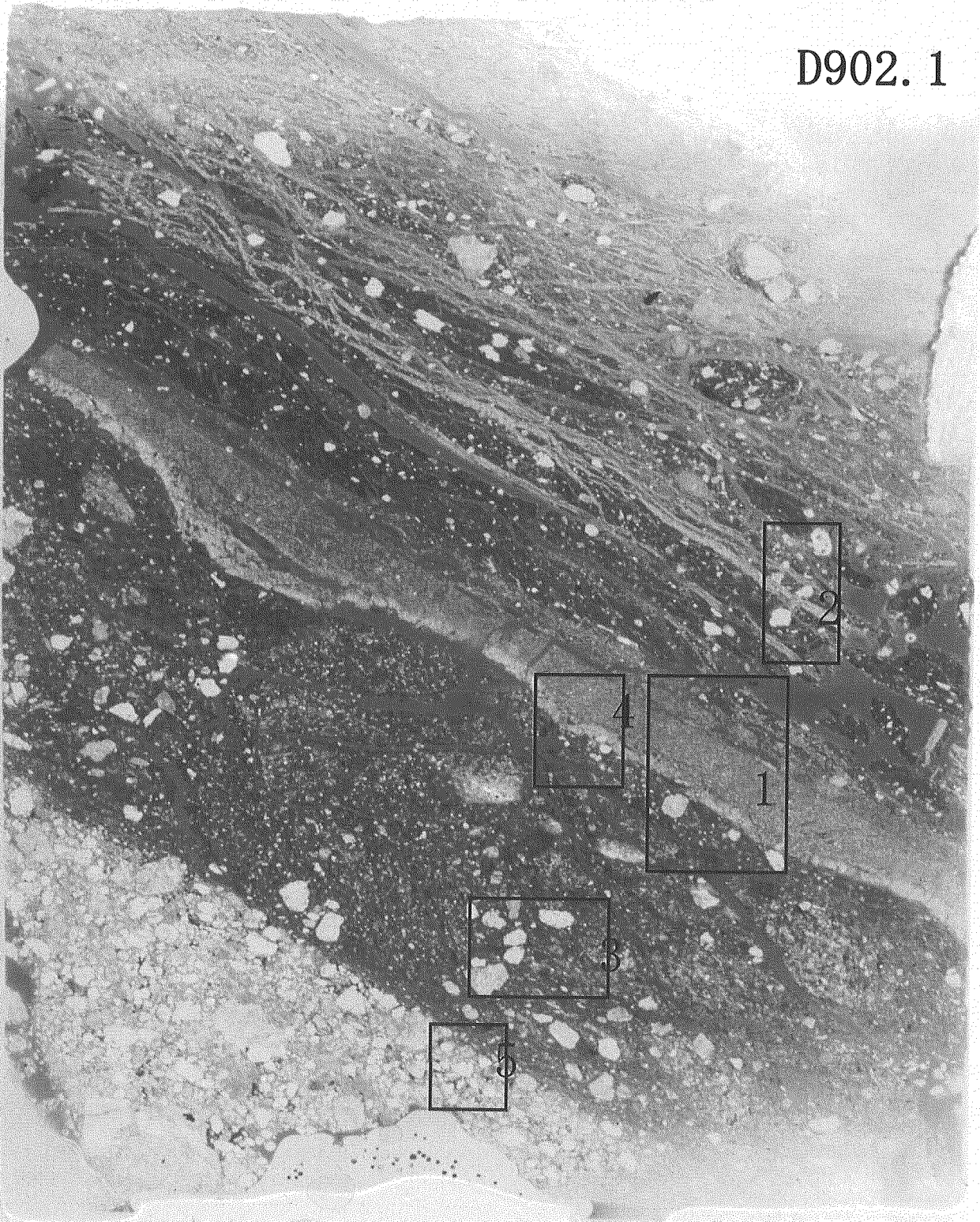
Table 2 contains reference numbers under the heading 'Location'. These numbers refer to the location on the sample that was analysed. This appendix contains an annotated image of each sample illustrating these locations. The locations are approximate within the limits of the resolution of the images and the fine grain size of the samples in some instances.

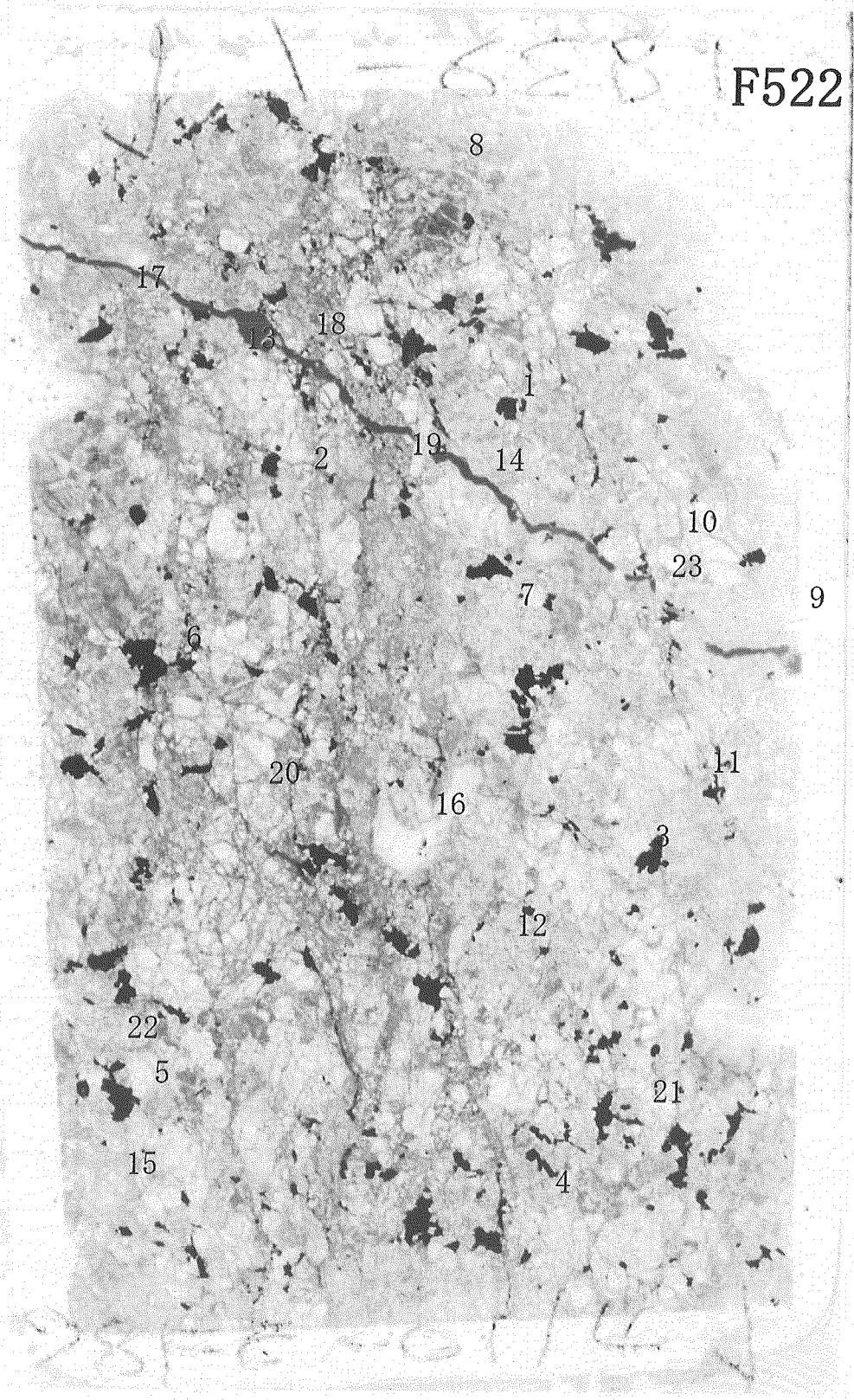


D903



D902. 1





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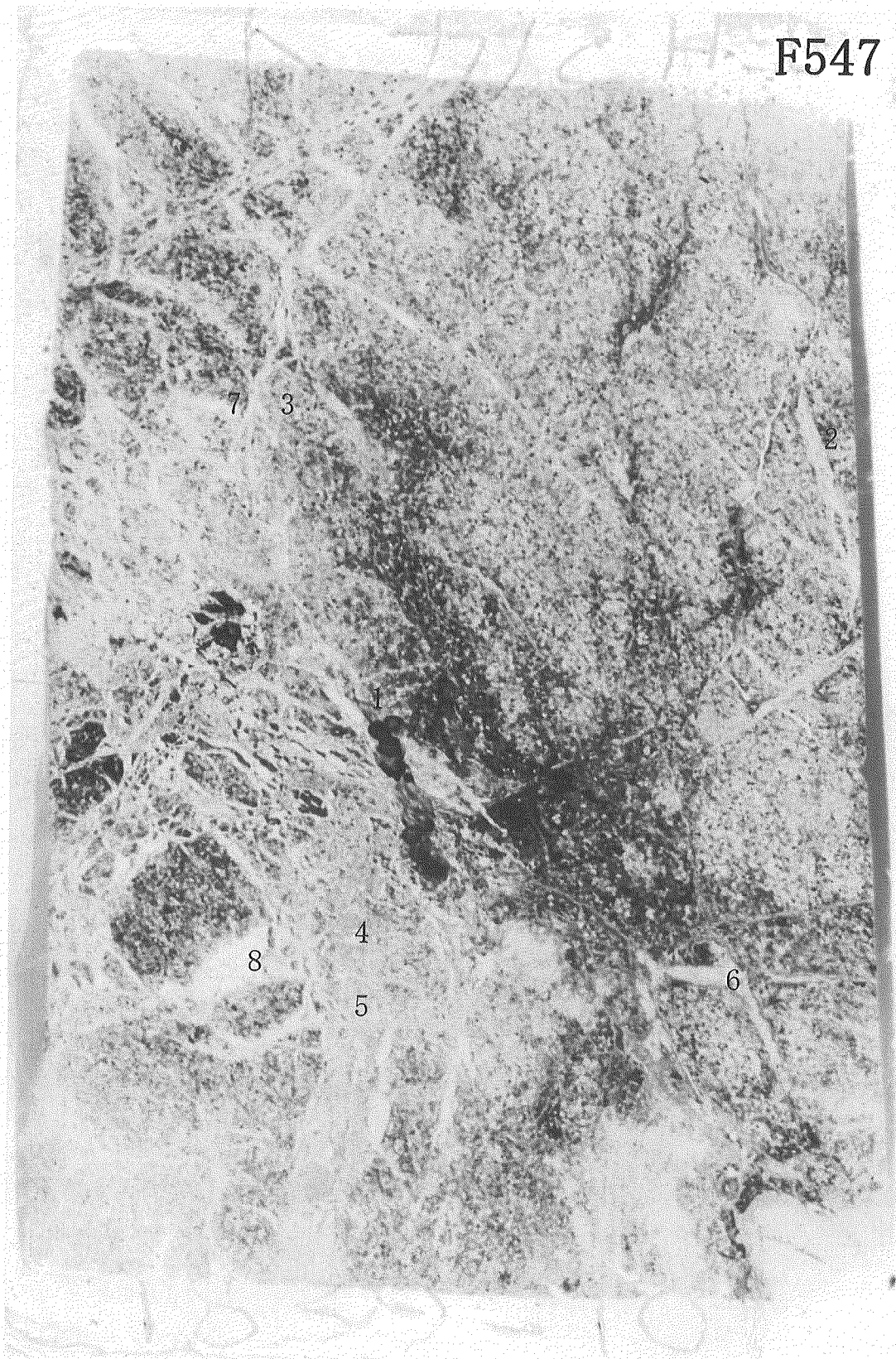
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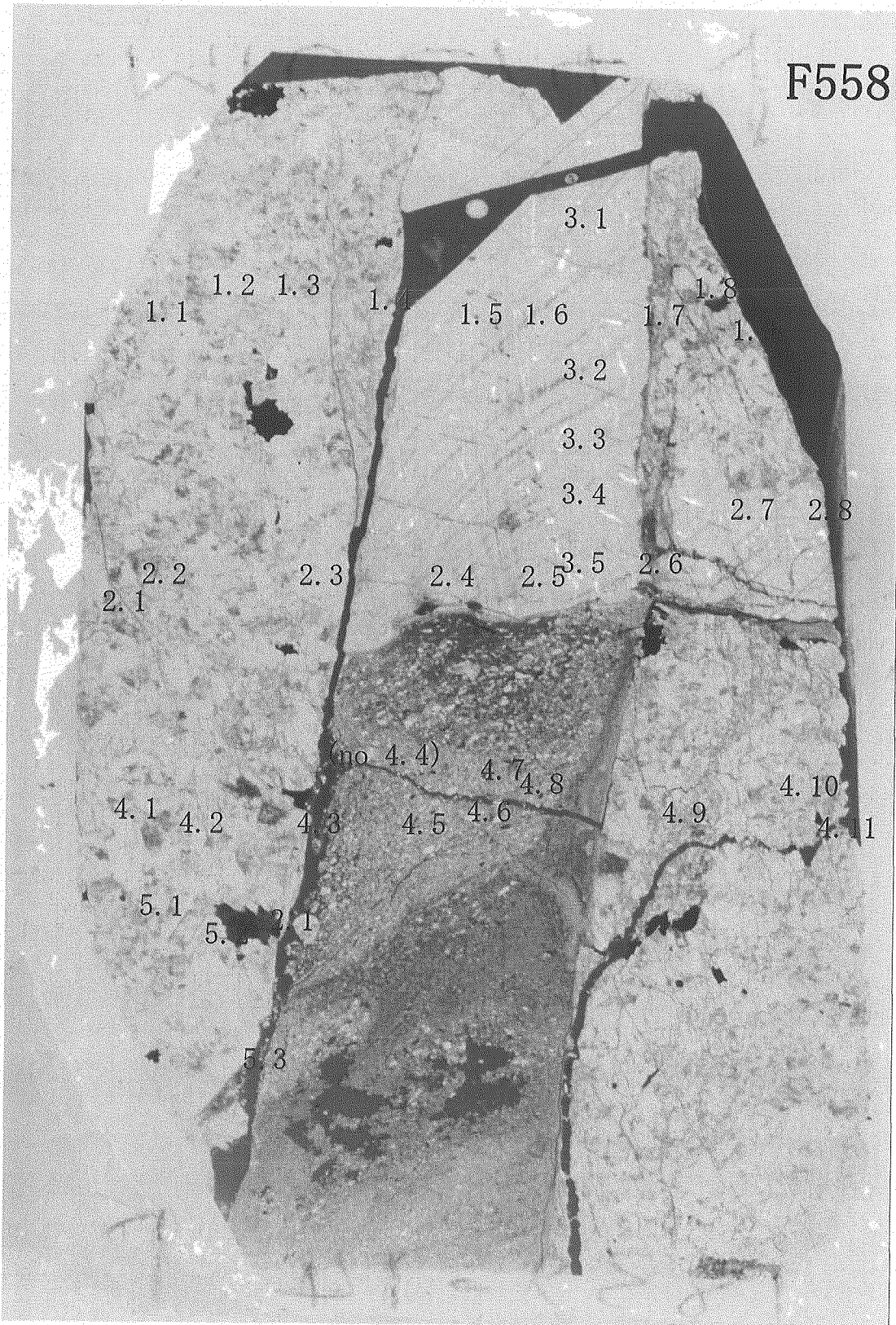
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F534

