Glass Mountain
COMPANY and CONTRACTOR
REPORTS, MEMORANDA, and DATA SHEETS
EGI, Univ. of Utah, Salt Lake City, UT

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Carrier, D.L., 1986, Evaluation of subsurface trace-element and whole-rock oxygen-isotope data from the Medicine Lake highland, California: Internal Memorandum (Unocal Geothermal) to A. Schriener.

Carrier, D.L., 1987, Untitled – Report on mineralogy, fluid inclusions, and select temperature data for the Glass Mountain Federal Unit geothermal prospect: Internal Memorandum (Unocal Geothermal), 24 p.

Carrier, D.L., 1987, Analysis of mineralogy and fluid-inclusion data from Glass Mountain area temperature boreholes: Internal Memorandum (Unocal Geothermal) to A. Schriener, 39 p.

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Carrier, D.L., 1989, Glass Mountain borehole and well data: Internal memorandum (Unocal Geothermal) to D. Sussmann, 39 p.

Carrier, D.L., 1989, Hydrothermal alteration and well lithologies for Glass Mountain wells GMF 68-8, GMF 31-17, and GMF 17A-6: Internal Memorandum (Unocal Geothermal) to D. Sussmann, 28 p., numerous tables, figures, and appendices.

Crecraft, H.R., 1988, Preliminary geochemical evaluation of first 68-8 flow test, 07/8/88 to 07/09/88: Internal Memorandum (Unocal Geothermal) to R.F. Dondanville, 3 p.

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Essner, P., 1992, Medicine Lake magnetotelluric survey – Relevance to Evaluation of CECI lease position: CalEnergy Interoffice Memorandum to E. Layman, 4 p.

Gallup, D.L., and Obando, M.E., 1990, GMF 68-8 fluid analyses: Internal Memorandum (Unocal Geothermal) to T.W. Kelley, 3 p.

Hausback, B.P., 1984, Surficial geology of the Medicine Lake highland: Internal Memorandum (Unocal Geothermal) to A. Schriener, 20 p., with geologic map.

Hulen, J.B., 1985, Bulk and layer-silicate mineral zoning in well 68, as determined by X-ray diffraction: UURI/ESL Report to Unocal Geothermal (October 29, 1985), 7 p.

Hulen, J.B., 1988, XRD mineralogy and reconnaissance petrography of 16 samples from wells "6" and "8": UURI/ESL Report to D. Carrier (Unocal Geothermal), March 16, 1989, 8 p.

Hulen, J.B., 1984-1985(?) – Miscellaneous tabulated XRD mineralogy of samples from various Medicine Lake geothermal boreholes, including **28-32** (*10 samples*), **29-1** (*6 samples*), **17A-6** (*30 samples*), "12" (**ML 65-26**; *7 samples*), "13" (**ML 84-17**; *6 samples*), "9" (**GMF 17-6**; *12 samples*), "8" (**GMF 87-13**; *3 samples*), "11" (**ML 57-11**; *6 samples*), "6" (**ML 75-6**; *7 samples*), "7" (**ML 2-81**; *1 sample*); **44-33** (*8 samples*); **36-28** (*7 samples*); **56-3** (*6 samples*); **51-2** (*7 samples*); **52-30** (*7 samples*); **54-19** (*8 samples*); "**well 68**" (16 samples); **14-23** (*7 samples*); **18-34** (*6 samples*); **27-27** (*6 samples*); **62-21** (*5 samples*); **68-16** (*8 samples*); **86-23** (*6 samples*), **54-19** (*8 samples*), and **56-3** (*6 samples*), ***Note*** *– these analyses were originally accompanied by short letter reports.*

Lutz, S.J., 1988, Untitled – XRD mineralogy and reconnaissance petrography of 10 samples from well "8" (otherwise unidentified): Letter report (October 18, 1988) to Daniel Carrier (Unocal Geothermal), 6 p.

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Lutz, S.J., 1990, Untitled – XRD mineralogy and reconnaissance petrography of 27 samples from well "13" (otherwise unidentified at the time of analysis, but now know to be rotary well 87-13): UURI/ESL report to R.C. Thompson, 9 p.

McDaniel, A., and Bodell, J., 1985, Structural assessment of Medicine Lake highland: Internal Memorandum (Unocal Geothermal) to A. Schriener, Jr.

Nordquist, G., 1985, Updated geophysical interpretation of the Medicine Lake volcano: Internal Memorandum (Unocal Geothermal) to R.G. Daniel and A. Schriener, Jr., 15 p., numerous maps and cross sections.

Nordquist, G., 1989, Preliminary MT results from Glass Mountain: Internal Memorandum (Unocal Geothermal) to Neil Stefanides, 1 p., with large map.

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Ostlund, H.G., 1989, Tritium analyses for Medicine Lake surface and geothermal waters: University of Miami, 2 Letter Reports (September 20 and October 25, 1989) to D.L. Carrier (Unocal Geothermal), 3 and 5 p., respectively.

Reagan, M., 1990, U decay-series diagrams for rocks from the Medicine Lake highlands: University of Iowa, Letter Report to D. Jacobs, 7 p.

Reynolds, T.J., 1987, Fluid-inclusion studies of two samples from a geothermal system: Fluid, Inc. Report (April 16, 1988) to Brian Smith (Unocal Science and Technology), 4 p. Note -- the two samples are from veins collected from depths of 3448 ft and 3905 ft in well **45-36**; the vein samples contain quartz, prehnite, calcite, and laumontite in various combinations.

Smith, B.M., 1984, Oxygen-isotopic and petrographic results for samples from three drill holes, Medicine Lake volcano, California: Internal Memorandum (Unocal Geothermal) to A. Schriener, 6 p.

Weiss Associates, 1997, Baseline hydrogeology evaluation report for Telephone Flat geothermal project, Medicine Lake, California: Consulting Report prepared for CalEnergy Company, Inc., 30 p., numerous tables and figures.

PAPERS AND TECHNICAL REPORTS

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Bargar, K.E., and Keith, T.E.C., 1997, Estimated temperatures for geothermal drill holes at Medicine Lake volcano, northeastern California, based on fluid-inclusion and hydrothermal mineralogy studies: U.S. Geological Survey, Open-File Report 97-716, 116 p.

Broker, M.M., Christopherson, K., and Haller, R., 1982, E-field ratio telluric survey near Medicine Lake in the Medicine Lake highlands caldera, Siskiyou County, California: *U.S. Geological Survey*, Open-File Report 82-900, 10 p.

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Lowenstern, J.B., Donnelly-Nolan, J.M., and Grove, T.L., 1998, Granite inclusions in Holocene lavas of Medicine Lake volcano, California, USA – Clues to subsurface geology: International Association of Volcanology and Chemistry of the Earth's Interior, Abstracts Volume, Capetown, South Africa, July 1998, p. 36.

Lowenstern, J.B., Wooden, J.L., Lanphere, M., Persing, H.M., Donnelly-Nolan, J.M., and Grove, T.M., 1999, Late Quaternary U-Pb and Ar-Ar ages of granitic intrusions beneath Medicine Lake volcano, California: *American Geophysical Union*, Fall Meeting, Abstracts with Programs.

Lutz, S.J., Hulen, J.B., and Schriener, A., Jr., 2000, Alteration, geothermometry, and granitoid intrusions in well 31-17, Medicine Lake volcano geothermal system, California: *Stanford University*, 25th Workshop on Geothermal Reservoir Engineering, Proceedings, 8 p.

Richard, M., Shuster, D., and McClain, D., 1998, Medicine Lake milestones: Geothermal Resources Council Bulletin, April-May, 1998, p. 70-75.

Williams, C.F., and Grubb, F.V., 2000, Thermal constraints on the sealing efficiency of the caprock overlying the Medicine Lake hydrothermal system: Stanford University, 25th Workshop on Geothermal Reservoir Engineering, Proceedings.

MISCELLANEOUS ITEMS

1. *April 26, 1999* – Comments and suggestions by Joe Beall concerning an unknown paper on the Glass Mountain geothermal area.

2. *April 26, 1999* -- Two isothermal cross sections through the Telephone Flat and Fourmile Hill areas, prepared by Joe Beall

3. *January 1999* – Letter to Mark Walters from John Finger, Sandia National Laboratories, outlining Sandia's understanding of CalEnergy's Medicine Lake drilling and development project, and of Sandia's potential role in that project.

4. *March 2, 1999* – Fax transmittal from Alex Schriener, CalEnergy – Parts of the Telephone Flat and Fourmile Hill EIR-EIS reports

5. Set of Viewgraph copies (paper) for a general presentation on the Medicine Lake/Telephone Flat geothermal area.

6. *December 31, 1981* -- Potassium-argon age determination for sample ML 2-750, by Krueger Enterprises, Inc. – *The sample is described as a "dacite or granodiorite", and is dated at 7 Ma.*

7. *December 3, 1981* -- Table of arsenic, copper, zinc, and mercury analyses for "ML-2-81" – completed and reported by Rocky Mountain Geochemical Corporation.

8. *1997* – Listing of geothermal wells shipped from Brea, CA, to Ridgecrest, CA, March, 1997.

MISCELLANEOUS BOREHOLE DATA

1. Core hole **87-13** -- completion report – *February 10, 1983.*
2. GM **87-13** mud log – completed *October 5, 1982.*
3. Core hole **87-13** (ML 3-82) – two temperature logs – *October 5, 1982.*
4. Corehole **87-13 deepening** – completion report – *November 4, 1991.*
5. Corehole **87-13 deepened** – temperature log completed by Colin Williams, U.S. Geological Survey – *August 19, 1999.*
6. Corehole **87-13 deepening** – mudlog – completed *October 9, 1991.*
7. Corehole **87-13 deepening** – completion record supplement (with new flow-test data).
8. Borehole **87-13**, 0-3010 ft – completion record – *October 31, 1989.*
9. Borehole **87-13**, 0-3010 ft – mud log (Exlog Smith) – *October 28, 1989*
10. Borehole **17-6** -- Log of generalized lithology; mercury and arsenic concentrations
11. Borehole **17-6** -- Occidental Geothermal mudlog – completed *November 2, 1982*
12. Borehole **68-8** – Completion schematics – *August 2, 1988*
13. Well **GMF 31-17** – Unocal Geothermal mud log – completed *September 13, 1988.*
14. Well **GMF 68-8** – Well Summary (lithology, alteration, temperature, etc.) on one medium-sized sheet.
15. Well **GMF 68-8** – Unocal Geothermal mud log – completed *August 19, 1985.*
16. Well **GMF 68-8 deepening** – Unocal Geothermal mudlog – completed *August 2, 1988.*
17. Well **ML 17A-6** – List of aqueous fluid compositions for samples collected at various depths.
18. Well **ML 17A-6** – Schematic of hole condition on *October 21, 1984.*
19. Well **GMF 31-17** – Completion schematic.
20. Well **GMF 31-17** – Temperature and pressure logs run in *late 1998.*
21. Well **GMF 17A-6** – Geologic summary and summary temperature log.

Borehole summaries, including lithology, mineralogy, temperature, and oxygen isotopic composition, As, & Hg (parameters in various combinations)

65-26
75-6
84-17
87-13
14-27
17-6

Borehole summaries, including lithology, mineralogy, temperature, oxygen isotopic comp., As, & Hg (continued)

45-36
52-30
54-19
56-3
44-33
17A-6
57-11
Several others, but well ID's omitted when photocopying.

MEDICINE LAKE THIN SECTIONS CURRENTLY (JANUARY 2, 2002) AT EGI

1. 3 X 2" sections:

- "XLSP-2A" (no other identification; 2 sections)
- "XLSP-2B" (no other identification; 2 sections)
- ML 62-21, 1796 (w/left-pointing arrow; 2 sections)
- ML 62-21, 2115 (w/upward-pointing arrow)
- ML 62-21, 2115 (w/downward-pointing arrow)
- ML 62-21, 2134.5 (w/ upward-pointing arrow; 2 sections)
- ML 62-21, 1590 (2 sections)
- GMF 28-32, 4500
- GMF 28-32, 4330
- GMF 28-32, 4430
- GMF 28-32, 4473
- "4430" (no other identification)
- GMF 28-32, 4167
- GMF 28-32, 4022
- GMF 28-32, 3890
- GMF 28-32, 3650

The following are impregnated with magenta epoxy:

- "17-84-20-89228" (w/upward-pointing arrow)
- "6593H" (no other identification)
- "6595H" (no other identification)
- "8379H" (no other identification)
- "8403H" (no other identification)
- "8409H" (no other identification)
- "FLC_1" (no other identification)
- "4292.6" (no other identification)
- "17-84-23-89228" (with right-pointing arrow)
- "6600H" (no other identification)
- "4294.2" (with upward-pointing arrow)
- GMF 87-13, 3923 ft
- GMF 87-13, 3256 ft
- GMF 87-13, 4367 ft
- GMF 87-13, 3774 ft
- "FLA" (no other identification)
- "FLB" (no other identification)
- GMF 87-13, 5574 ft
- GMF 87-13, 4993 ft

2. Magmachem Study

- R9506 – $ML291^{ST}$ – 866
- R9506 – $ML291^{ST}$ – 952B
- R9506 – $ML291^{ST}$ – 952A
- R9506 – $ML291^{ST}$ – 1237

3. Standard-sized thin sections, loose

- "GF felsite" (2 sections)
- 17A-6, 8280-90, polished, carbon-coated, microprobed
- 17A-6, 8160-70, as above

- "68" (no other identification), 2560-2580, as above
- 17A-6, "675/60", polished
- 17A-6, 7900-10, polished, carbon-coated, microprobed
- 17A-6, 8240-50, as above
- 17A-6, 8820-40, as above
- 17A-6, 8060-70, as above
- 17A-6, 7960-70, as above
- 17A-6, 7710-20, polished
- 17A-6, 7610-20, polished
- 17A-6, 7660-70, polished
- 17A-6, 7700-10, polished
- also "8-1", grain-mount TS plug

3. "Well 13"
   - 160
   - 200
   - 300
   - 400
   - 600
   - 800
   - 1000
   - 1100
   - 1200
   - 1300
   - 1400

   "Well 13", continued

   - 1460
   - 1500
   - 1600
   - 1710
   - 1800
   - 1890
   - 2000
   - 2100
   - 2200
   - 2300
   - 2390
   - 2400
   - 2450
   - 2500

4. ML 68-8

   - 6700
   - 6800
   - 6900
   - 7000
   - 7100
   - 7200
   - 7400
   - 7500

- 7600
- 7800
- 7900
- 8000
- 8100
- 8300
- "8-6591"
- "8-6595"
- "8-6601"
- "8-8405"
- "8-8409"
- "9-8413"
- "8-8417"
- "8-F2"
- 8200
- 8944.2

5. "Well 13"
   - "6-4"
   - "6-1"
   - "8-8"
   - "8-3"
   - "8-5"
   - "8-4"
   - "8-2"
   - "8-1"
   - "6-8"
   - "6-7"
   - "6-6"
   - "8-7"
   - "6-3"
   - "6-2"
   - "6-5"
   - "8-6"

6. ML 51-2 (standard thin sections)

   - 173
   - 266
   - 275
   - 309
   - 330
   - 392
   - 404
   - 404.5
   - 421
   - 752
   - 901
   - 953
   - 990
   - 1013
   - 1250
   - 1368

ML 51-2, continued

- 1434
- 1435
- 1502
- 1545
- 1817

7. ML 52-30 (standard thin sections)

- 326
- 401
- 428
- 488
- 522
- 707
- 761
- 762
- 793
- 921
- 1065
- 1106
- 1210
- 1356
- 1475
- 1592
- 1636
- 1687
- 1794
- 1894
- 1950

8. ML 54-19 (standard thin sections)

- 46
- 163
- 290
- 365
- 443
- 463
- 562
- 650
- 747
- 889
- 983
- 1058
- 1083
- 1186
- 1292
- 1509
- 1597
- 1684
- 1774

ML 54-19, continued

- 1927
- 2191

9. ML 57-11 (standard thin sections)

- 150
- 251
- 356
- 484
- 719
- 797
- 939
- 1096
- 1189
- 1292
- 1391
- 1491
- 1593
- 1707
- 1824
- 1898
- 2069
- 2130
- 2140
- 2376
- 2514
- 2795

10. ML 17-6 (standard thin sections)

- 10
- 100
- 200
- 300
- 390
- 500
- 600
- 690
- 800
- 900
- 1000
- 1100
- 1200
- 1290
- 1400
- 1510
- 1600
- 1800
- 1900
- 2010
- 2300

ML 17-6, continued

- 2400
- 2500
- 2600
- 2700
- 2800
- 2900
- 3000
- 3100
- 3200
- 3300
- 3400
- 3500
- 3600
- 3700
- 3800
- 3900
- 4000

11. ML 17A-6 (standard thin sections)

- 200
- 500
- 550
- 620
- 950
- 1100
- 1400
- 1600
- 1800
- 2000
- 2100
- 2400
- 2750
- 2980
- 3040
- 3260
- 3400
- 3500
- 3600
- 3750
- 3900
- 3960
- 4100
- 4300
- 4540
- 4600
- 4750
- 4900
- 5070
- 5400
- 5730

ML 17A-6, continued

- 5820
- 5950
- 6150
- 6300
- 6600
- 6790
- 6900
- 7200
- 7550
- 7710
- 7750
- 7800
- 8100
- 8400
- 8700
- 9000
- 9300
- 9600

12. ML -1 (standard thin sections)

- 150A
- 150B
- 170A
- 170B
- 200A
- 200B
- 250
- 320
- 400
- 450
- 480
- 520
- 550
- 640

13. ML 2-81 (standard thin sections)

- 50
- 120
- 150
- 160
- 250
- 280
- 370
- 370B
- 520
- 600

14. GMF 56-3 (standard thin sections)

- 226.7
- 271
- 384
- 634
- 678
- 718
- A
- A
- B
- C
- C
- 841
- 841B
- 939
- 939B
- 1031
- 1058
- 1064
- 1064B
- 1113
- 1113B
- 1153
- 1153B
- 1322
- 1322B
- 1533
- 1533B
- 1533C
- 1723
- 1723B

15. GMF 87-13 (standard thin sections)

- 247
- 269
- 331
- 355
- 368
- 749
- 815
- 888
- 902

16. GMF 84-17 (standard thin sections)

- 46
- 115
- 229
- 340
- 532
- 560

GMF 84-17, continued

- 569
- 641
- 696
- 849
- 993
- 1023
- 1055

17. GMF 44-33 (standard thin sections)

- 10
- 100
- 200
- 310
- 400
- 500
- 600
- 700
- 900
- 1000
- 1100
- 1200
- 1400
- 1600
- 1700
- 1800
- 1900
- 2000
- 2100
- 2260

18. GMF 68-8 (standard thin sections)

- 40
- 140
- 140B
- 180
- 340
- 440
- 640
- 840
- 900A
- 960
- 1020
- 1020B
- 1240
- 1240B
- 1340
- 1340B
- 1340 sawed
- 1460

GMF 68-8, continued

- 1640
- 1760
- 1960
- 2020
- 2120
- 2240
- 2380
- 2380B
- 2660
- 2660B
- 2770
- 3020
- 3040
- 3440
- 3440B
- 3480
- 3740
- 3820
- 3940
- 3940B
- 4140
- 4140B
- 4220
- 4240
- 4360
- 4380
- 4380B
- 4420
- 4420B
- 4520
- 4560
- 4620
- 4620B
- 4680
- 4760
- 4760B
- 4820
- 4820B
- 4920
- 4920B
- 4960
- 5020
- 5040
- 5060
- 5240
- 5340
- 5440
- 5340
- 5440
- 5440B
- 5640

GMF 68-8, continued

- 5840
- 5980
- 6120
- 6260S (shaker)
- 6260D (desilter)
- 6380 D
- 6380S
- 6440S
- 6560S
- 6560D
- "8-1"
- "8-2"
- "8-3"
- "8-4"
- "8-5"
- "8-6"
- "8-7"
- "8-8"
- "8-9"
- "8-10"
- "8-11"
- "8-12"
- "8-13"
- "8-14"
- "8-15"
- "8-16"
- "8-17"
- "8-17B"

19. ML 14-23 (standard thin sections)

- 95
- 444
- 453
- 495
- 529
- 647
- 768
- 868
- 974
- 1068
- 1086
- 1173
- 1312
- 1437
- 1465
- 1479
- 1562
- 1679
- 1796
- 1896

ML 14-23, continued

- 1919
- 1993
- 2046
- 2084
- 2188
- 2285
- 2366
- 2381
- 2487
- 2634
- 2730
- 2813
- 2916
- 2998

20. ML 36-28 (standard thin sections)

- 371
- 476
- 579
- 773
- 884
- 996
- 1093
- 1180
- 1296
- 1415
- 1518
- 1725
- 1936
- 2084
- 2139

21. ML 65-26 (standard thin sections)

- 494
- 594
- 696
- 794
- 884
- 989
- 1073
- 1193
- 1293
- 1389
- 1505
- 1616
- 1646
- 1800
- 1944
- 2055 & 2152

22. ML 75-6 (standard thin sections)

- 351
- 3??
- 393
- 484
- 572
- 683
- 786
- 861
- 957
- 1054
- 1134
- 1267
- 1444
- 1482
- 1640
- 1743
- 1827
- 1858
- 1858B
- 1888
- 1908
- 1925

23. GMF 28-32 (standard thin sections)

- 440
- 460
- 480
- 860
- 970
- 1050
- 11450
- 1170
- 1260
- 1280
- 1400
- 1500
- 1560
- 1600
- 1640
- 1710
- 1830
- 1880
- 1940
- 1950
- 2030
- 2110
- 2150
- 2240
- 2320
- 2360

GMF 28-32, continued

- 2480
- 2520
- 2600
- 2610
- 2710
- 2870
- 2950
- 2990
- 3120
- 3290
- 3380
- 3460

24. GMF 45-36 (standard thin sections)

- 100
- 360
- 480
- 600
- 850
- 870
- 1000
- 1100
- 1230
- 1410
- 1470
- 1620
- 1780
- 1860
- 1940
- 1990
- 2060
- 2140
- 2200
- 2350
- 2390
- 2420
- 2530
- 2620
- 2750
- 2880
- 3000
- 3100
- 3220
- 3320
- 3380
- 3430
- 3520
- 3600
- 3720
- 3810, 3870, & 3970

25. GMF 31-17 (standard thin sections)

- 410
- 810
- 1010
- 1210
- 1410
- 1610
- 1810
- 2020
- 2220
- 2420
- 2620
- 2820
- 3020
- 3220
- 3400
- 3600
- 3800
- 4000
- 4100
- 4200
- 4300
- 4400
- 4500
- 4600
- 4700
- 4800
- 4900
- 5000
- 5100
- 5300
- 5400
- 5500
- 5600
- 5700
- 5800
- 5900
- 6000
- 6100
- 6200
- 6300
- 6400
- 6500
- 6600
- 6700
- 6800
- 6900
- 7000
- 7100
- 7200
- 7300
- 7400

GMF 31-17, continued

- 7500
- 7500
- 7600
- 7700
- 7800
- 7900
- 8000
- 8100
- 8160
- 8200
- 8300
- 8400
- 8500
- 8600
- 8700
- 8418 (core)
- 8420 (core)
- 8422 (core)
- 8424 (core)
- 8425 (core)
- 8423 (core)
- 8600
- 8700
- 31-17-1 (800)
- 31-17-2 (1100)
- 31-17-3 (1300)
- 31-17-4 (1790)
- 31-17-5 (2100)
- 31-17-6 (2300)
- 31-17-7 (2840)
- 31-17-8 (3240)
- 31-17-9 (3870)
- 31-17-10 (4220)
- 31-17-11 (4480)
- 31-17-12 (4940)
- 31-17-13 (5230)
- 31-17-14 (5320)
- 31-17-15 (5780)
- 31-17-16 (6080)
- 31-17-17 (6560)
- 31-17-18 (7020)
- 31-17-19 (7450)
- 31-17-20 (8030)
- 31-17-21 (8090)
- 31-17-22 (8250)
- 31-17-23 (8787)
- 31-17-24 (8420)
- 31-17-25 (8422)

26. "Misc. Med. Lake" – "Hausback mapping, D. Jacobs, Rainbow Mtn" – 37 standard thin sections.

27. ML (?) 82-9 (standard thin sections)

    - 150-80
    - 230-60
    - 710-40
    - 1040-70
    - 2410-40
    - 2680-2710
    - 2840-70
    - 2870-90
    - 2960-90
    - 3140-50
    - 3170-3200
    - 3290-3320
    - 3440-70