DOI: 10.1180/minmag.2016.080.044

Supplementary 1. Further details for the selected candidate reference samples.

Z01 and fbN: Natrolite, Dean Quarry, St. Keverne, Lizard, Cornwall, U.K. OSGrid* SW 803 203 (*U.K. Ordnance Survey grid references: all taken from listings in Wilson et al., 2003).

These are two identical pieces of a cluster of white, prismatic, up to 5cm in length, crystals, with a feint pink coating presumed to be iron oxide. The geological setting is within a host grabbroic intrusion, in hydrothermal cavities - a 'gabbro pegmatite' - as described in Seager (1969). It is suggested by Seager (1969) that the hydrothermal suite, which includes Na-zeolites, calcite and prehnite, is post-serpentization and fault-related. This specimen was donated from the personal collection of Alan Dyer (co-author), and more information about the zeolite assemblage can be found in Wilson (1994).

Z02: Natrolite, Dean Quarry, St. Keverne, Lizard, Cornwall, U.K. OSGrid* SW 803 203

This specimen was supplied from the personal collection of Christopher Rochelle (of The British Geological Survey). Geological context is presumed to be the same as for Z01 from the same locality.

Z03: (Field no. FRN01) - Mesolite, Pitón de La Culata, Gran Canaria, Canary Islands, Spain. 27°58'32.76"N, 15°36'1.24"W

This specimen was collected by Francesco Stoppa and Andrea Sestri (sample FRN01) at an outcrop that belongs to the First Cycle of Gran Canaria volcanic activity. This activity, comprising rock types of trachytic and phonolitic compositions, began at 12 Ma and lasted for 4.5 Ma. Pitón de la Culata is a sub-volcanic, hauyne, phonolite body which occurs in the central area of the island (Caldera La Tejeda). The mesolite (white, radiating but massive) appears to have crystallized in a ~2-5cm wide, irregular vein or vug context (presumed hydrothermal), where no free voids are visible. Some interactions with the host rock are apparent from the slightly diffuse contacts and contact-parallel colour variability in host rock components.

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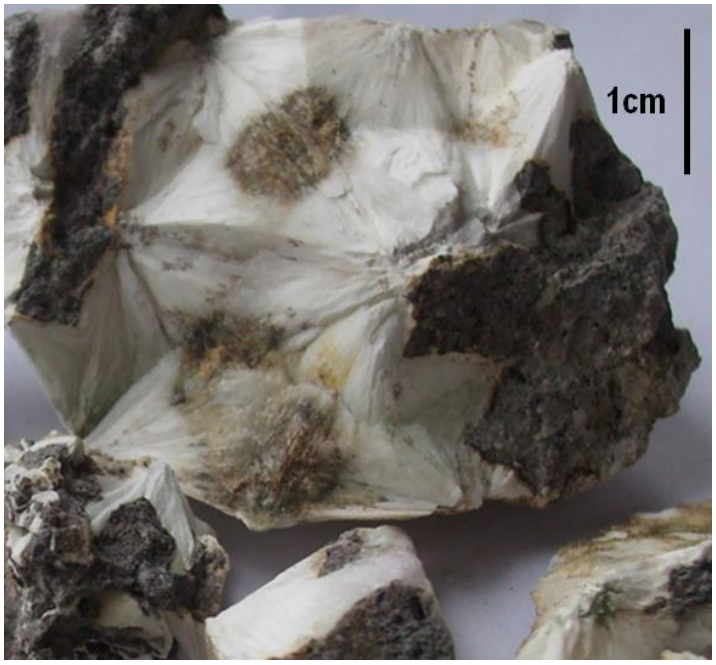

Z04: (H425, Rex Cook) - Analcime, Dean Quarry, St. Keverne, Lizard, Cornwall, U.K. OSGrid SW 803 203

Details of this locality are given above, for Z01 and fbN. The analcime of Z04 is from the partially open central part of a vein containing large, white crystals up to 2cm across. Crystal forms have the appearance of cubic trapezohedra. The specimen was supplied from the personal collection of Christopher Rochelle, sourced from Rex Cook of Nelson, Lancashire, U.K.

Z05-Z06: (Field no. IT60) – **Leucite-Analcime, Strada per Cima, ~1.5km NW of Rionero In Vulture, Monte Vulture, Italy.** 40°56'15.46"N 15°39'39.49"E

Specimen collected by Linda Campbell and Francesco Stoppa, from the northern rim of the Mele quarry, in the Rionero in Vulture area, eastern flanks of the Monte Vulture volcano. The <1-2cm leucite-analcime crystals are from a yellowish pyroclastic fallout horizon belonging to the Ventaruolo subsynthem (upper, right hand side of image *a*). A close-up view of the deposit is seen in image *b*, with the edge of a 12x18cm field note-book for scale. The yellow-green matrix is highly friable, and the clasts form a heterogeneous mix of volcanic lithics in addition to the leucite-analcime components (white, in image *b*). The cm-scale, fairly well sorted clasts appear to represent a coarser horizon than those immediately below and above, but other beds as seen in image *a* display considerable textural variation. It is suggested that leucite was erupted as discrete lapilli, which were then analcimized from volcanogenic-diagenetic processes. Details of the volcanic stratigraphy of Monte Vulture can be found in Giannandrea et al. (2006).

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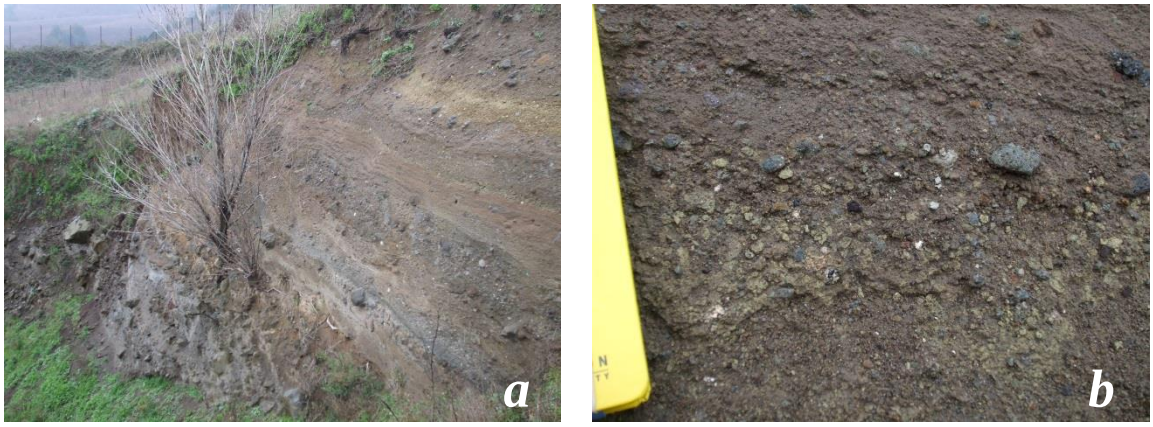

Z12: G.452.10 - Edingtonite, Old Quarry, NE of Old Kilpatrick, Dumbartonshire, Scotland, U.K. (Type locality, approximately 55°55'43 "N, 4°26'49 "W)

Specimen supplied by The National Museum of Scotland (NMS), Edinburgh. *'Edingtonite associated with thomsonite on matrix'* probably from the old quarry half a mile NE of Old Kilpatrick, Dumbartonshire. The host rocks are the 340Ma (Carboniferous) City Plateau Lavas (geological sketch map in Gallagher, 1958). It is part of the Matthew Heddle Collection of the NMS, acquired in 1897. Matthew Heddle was an important 19th century Scottish collector. The identification of edingtonite was confirmed by XRD analysis on 9th March 1977, XRD Photo 06169. The specimen was part of an exhibition at the Denver Mineral and Gem Show in 2004.

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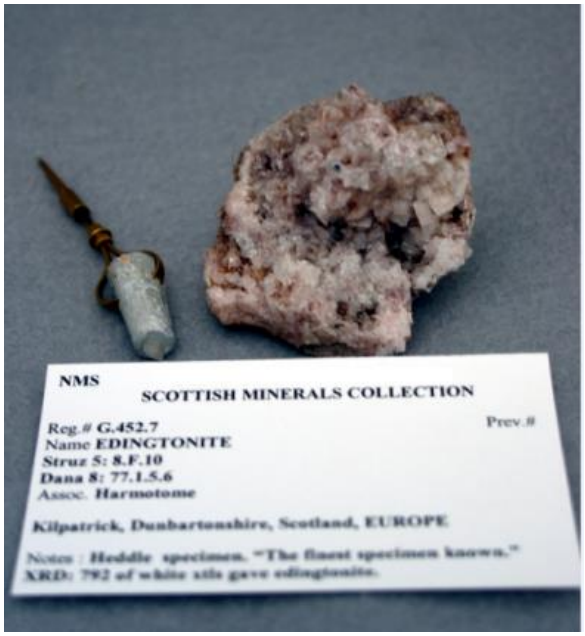
Z13: G.452.7 – Edingtonite, Kilpatrick, Dumbartonshire, Scotland, U.K. (Type locality, approximately 55°55'43 "N, 4°26'49 "W)

Specimen supplied by the NMS. *'Edingtonite crystals on harmotome twins – the finest specimen known'* [at the time of collection!]. Collected from Kilpatrick, Dumbartonshire. The host rocks are the 340Ma (Carboniferous) City Plateau Lavas (geological sketch map in Gallagher, 1958). It is part of the Matthew Heddle Collection. The identification of edingtonite was confirmed by XRD analysis on 17th March 1977, probably by Alex Livingstone. NMS Photo 0792. The specimen was part of an exhibition at the Denver Mineral and Gem Show in 2004.



Z14 and sbP: G.1971.13.1 - Brewsterite, Corantee vein, Strontian, Argyll, U.K. Latitude 56° 43'55.30N Longitude 5° 35'39.67W

Specimen supplied by the NMS, and collected by Brian Jackson (Curator of Mineralogy). Description by George C. Holliday (Geology Conservator): *"Large crystals of brewsterite cementing brecciated rock fragments from the underground workings of the Corantee Vein, Strontian, Scotland."*

fbH: Faujasite, Limberg, Sasbach, Kaiserstuhl, Germany. Latitude 48°14'N Longitude 7°62'E (approximate).

Specimen collected and labelled by the late Isobel Geldart, member of The British Micromount Society (BMS). Her extensive collection was purchased by Neil Hubbard after her death, and for the present study, the zeolites from it were supplied through Alan Dyer. The geological context and compositions of the zeolite assemblage from this locality is described in detail in Weisenberger and Spürgin (2009).

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sbZ: Chabazite, Flodigarry, Isle of Skye, U.K. OSGrid NG 463 711

Specimen collected and labelled by the late Isobel Geldart (BMS), as above. The zeolite assemblage is in association with Tertiary basalts. Information about this locality is best found from www.mindat.org, which is updated sporadically by members of its user-community. See http://www.mindat.org/loc-4697.html for Flodigarry.

sbW: Levyne, Moonen Bay, Diurnish, Isle of Skye, U.K. OSGrid NG 149 467

Specimen collected and labelled by the late Isobel Geldart (BMS), as above. The zeolite assemblage is in association with Tertiary basalts. Information about this locality is best found from www.mindat.org, which is updated sporadically by members of its user-community. See http://www.mindat.org/loc-2954.html for Moonen Bay.

Z17: BM 1980,1 – Wairakite, Tohi mine, Shizuoka, Japan

Specimen was purchased by The Natural History Museum of London (NHM), from the Mineralogical Research Company of San Jose, California, USA in 1980. Museum XRD data were collected to confirm its identity – reference 2997F (white crust). This gave a pattern that matched to wairakite + impurities of quartz. Register description: *"A white crystalline crust with intergrown quartz, analcime, etc… on an altered basalt."*

Z18: BM 1975,339 – Laumontite, Poonah, Bombay, Maharashtra, India

Specimen was purchased by the NHM from Brian Lloyd of Gregory Botley & Lloyd, London, in 1975. Identity not confirmed by XRD, as considered not needed due to adequate hand specimen description. It is of note that the material has not been kept in water. Many laumontites decompose in air, but this specimen has largely kept its form in comparison to others – although it is reasonable to suspect that it has dehydrated since the time it was purchased. Also the register description is indicative that it was probably dehydrated by the time of purchase, anyway. Register description: *"An aggregate of white opaque prisms."*

Z19: BM 1984,376 – Goosecreekite, Maharashtra, India

Specimen was purchased by the NHM from Jewel Tunnel Imports of Arcadia, California in 1984. Museum XRD data were collected to confirm its identity – reference 4081F (greyish-white composite crystals). This gave a pattern that matched to pure goosecreekite. Register description: *"Large composite greyish-white crystals on a crust of quartz crystals coating basalt with associated pink tabular stilbite."*

Z20: BM 1988,148 – Phillipsite, Matheran, Bombay, Maharashtra, India

Specimen donated to the NHM by Miss K Jeffery of Royal Holloway in 1988, and collected, described and identified as merlinoite in her doctoral thesis, Jeffery (1988). In a subsequent paper, (Jeffery et al., 1988), an XRD identification of merlinoite was reported, but without presentation of the data. In the present manuscript (Campbell et al., 2016), the XRD data in Figure 1 show that the material which was analysed for the microprobe investigation was phillipsite, not merlinoite. It is possible that the specimen is a heterogeneous mixture of

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zeolites, and that both merlinoite and phillipsite, which are known to occur together (Donahoe et al., 1990, Danisi et al., 2015), are present in the NHM sample, and that the pieces selected for the present study happen to be only phillipsite. If considered necessary, replicate XRD data could be obtained from the Museum specimen. Museum register description: *"Pinkish to white 'massive' material completely infilling vesicles within a pale grey basalt. Three specimens, all visually similar."*

Z21: BM 1980,7 – Edingtonite, Ice River, near Golden, Kootenay District, British Columbia, Canada

Specimen was purchased by the NHM from the Mineralogical Research Company of San Jose, California, USA in 1980. Identity not confirmed by XRD, as considered not needed due to the good reputation of the locality and to adequate hand specimen description. Register description: *"Aggregates of white to grey tabular crystals coating a cavernous matrix."*

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