

TABLE S1. Localities of apatite containing oriented inclusions and inferred formation processes.

Locality	Mineral inclusions and host rocks	Process	Reference
Pyrhotite			
Tromsø Nappe, North Norwegian Caledonides, Norway	UHP metamorphism, Silicate-rich carbonate rock, underwent decompression and retrogression	Exsolution + fluid mediated regime	Broska et al., 2014
UHP metamorphic terrain of the Sulu Area, China	UHP metamorphism: eclogite and retrograde eclogite	Exsolution	Zhu and Massonne, 2005, 2007
Rhodope metamorphic province, northeastern Greece	UHP event followed by a metamorphic overprint at granulite-facies conditions; kyanite-eclogites	Exsolution	Kostopoulos et al., 2010
Monazite			
Maowu body, Dabie-Sulu terrane, Dabie Mountains, China	UHP metamorphism: garnet clinopyroxenite	Exsolution	Liou et al., 1998 Zhang and Liou, 1999
UHP-terrain, Southern part of the Pohorje Mountains, Slovenia	UHP metamorphism (“Eoalpine”): monazite-bearing kyanite-garnet gneiss	Exsolution	Krenn et al., 2008
The Kiirunavaara deposit, Kiruna area, northern Sweden	Magnetite–apatite ore	Rock-fluid interaction	Harlov et al., 2002
Archean Hemlo gold deposit, Archean Hemlo-Heron Bay greenstone belt, Ontario, Canada	Middle amphibolite facies, with hydrothermal alteration following the peak regional metamorphism: hydrothermally altered muscovite schists	Rock-fluid interaction	Pan et al., 1993
Manitouwadge volcanogenic massive sulfide camp, Archean Manitouwadge greenstone belt, Ontario, Canada	Upper amphibolite facies, with hydrothermal alteration in the late stage: garnet-rich cordierite-orthoamphibole gneiss.	Rock-fluid interaction	Pan, 1997
Reinbolt Hills, East Antarctic Granulite Province, East Antarctica	Granulite facies: metamorphosed sillimanite-bearing pegmatoid	Metasomatic overprint	Ziemann et al., 2005
Monazite and xenotime			
Val Strona di Omegna, Ivrea–Verbano Zone, northern Italy	Granulite facies: pyroxene bearing metabasite	Dissolution–precipitation	Harlov and Foster, 2002
Kigluaik Mountains, antiformal gneiss terrane, Seward Peninsula, Alaska	Amphibolite to granulite facies: orthogneiss of tonalitic composition	Rock-fluid Interaction	Harlov and Foster, 2002
Val Sessera, Vereelli province, northern Italy	Granodiorite to aplite-like microgranite	Not noticed	Pigorini and Veniale, 1968
Gloserheia granite pegmatite, Precambrian Kongsberg-Bamble formation, Froland, Southern Norway	Granitic pegmatite	Exsolution + metasomatism	Almi, 1975

References cited:

- Almi, R. (1975) Mineralogy and Rare Earth Geochemistry of Apatite and Xenotime from the Gloserheia Granite Pegmatite, Froland, Southern Norway. *American Mineralogist*, 60, 607–620.
- Broska, I., Krogh Ravna, E.J., Vojtko, P., Janák, M., Konečný, P., Pentrák, M., Bačík, P., Luptáková, J., and Kullerud, K. (2014) Oriented inclusions in apatite in a post-UHP fluid-mediated regime (Tromsø Nappe, Norway). *European Journal of Mineralogy*, 26(5), 623–634, <http://doi.org/10.1127/0935-1221/2014/0026-2396>.
- Harlov, D.E., and Foster, H.-J. (2002) High-Grade Fluid Metasomatism on both a Local and a Regional Scale: the Seward Peninsula, Alaska, and the Val Strona di Omegna, Ivrea-Verbano Zone, Northern Italy. Part I: Petrography and Silicate Mineral Chemistry. *Journal of petrology*, 43, 769–799, <http://doi.org/10.1093/petrology/43.5.769>.
- Harlov, D.E., Andersson, U.B., Förster, H.-J., Nyström, J.O., Dulski, P., and Broman, C. (2002) Apatite-monazite relations in the Kiirunavaara magnetite-apatite ore, northern Sweden. *Chemical Geology*, 191, 47–72, [http://doi.org/10.1016/S0009-2541\(02\)00148-1](http://doi.org/10.1016/S0009-2541(02)00148-1).
- Kostopoulos, D.K., Moulas, E., and Burg, J.-P. (2010) First report of apatite with pyrrhotite exsolution lamellae in retrogressed Ky-eclogites from the Rhodope UHP metamorphic province (Greece). *Proceeding from IMA congress, Budapest*, 458.
- Krenn, E., Ustaszewski, K., and Finger, F. (2008) Detrital and newly formed metamorphic monazite in amphibolite-facies metapelites from the Motajica Massif, Bosnia. *Chemical Geology*, 254 (3–4), 164–174, <https://doi.org/10.1016/j.chemgeo.2008.03.012>.
- Liou, J.G., Zhang, R.Y., Ernst, W.G., Rumble, D., and Maruyama, S. (1998) Chapter 2. High-pressure minerals from deeply subducted metamorphic rocks. In R. J. Hemley, Eds., *Ultrahigh-*

- pressure mineralogy: Physics and chemistry of the Earth's deep interior, p. 33–96. Berlin, Boston: De Gruyter, <https://doi.org/10.1515/9781501509179-004>.
- Pan, Y. (1997) Zircon- and monazite-forming metamorphic reactions at Mantiowadge, Ontario. *The Canadian Mineralogist*, 35, 105–118. <http://pubs.geoscienceworld.org/canmin/article-pdf/35/1/105/3435559/105.pdf>
- Pan, Y., Fleet, M.E., and Macrae, N.D. (1993) Oriented monazite inclusions in apatite porphyroblasts from the Hemlo gold deposit, Ontario, Canada. *Mineralogical Magazine*, 57, 697–707, <https://doi.org/10.1180/minmag.1993.057.389.14>.
- Pigorini, B., and Veniale, F. (1968) L'apatite accessoria nelle diverse facies litologiche delle formazioni granitoidi della Val Sessera (Vercelli). *Rendiconti della Societa Italiana di Mineralgia e Petrologia*, 24, 283-312,(In Italian).
- Zhang, R.Y., and Liou, J.G. (1999) Exsolution lamellae in minerals from ultrahigh-pressure rocks. *International Geology Review*, 41(11), 981–993, <https://doi.org/10.1080/00206819909465184>.
- Zhu, Y., and Massonne, H.J. (2005) Discovery of pyrrhotite exsolution in apatite. *Acta Petrologica Sinica*, 2, 405–410.
- Zhu, Y.F., and Massonne, H.J. (2007) Pyrrhotite exsolution texture of apatite in the main borehole of the Chinese Continental Scientific Drilling (CCSD). *Acta Petrologica Sinica*, 23 (12), 3249–3254.
- Ziemann, M.A., Förster, H.-J., Harlov, D.E., and Frei, D. (2005) Origin of fluorapatite-monazite assemblages in a metamorphosed, sillimanitebearing pegmatoid, Reinbolt Hills, East Antarctica. *European Journal of Mineralogy*, 17(4), 567–580, <https://doi.org/10.1127/0935-1221/2005/0017-0567>.