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Nb-Ta fractionation in peraluminous granites: A marker of the magmatic-hydrothermal transition

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Location	Igneous province	Granite	Age	Related deposit		Reference
Western Europe	French Armorican Massif	Lizio	ca. 316 Ma	Sn	U leached during hydrothermal alteration Apical zone facies	Tartèse and Boulvais, 2010
		Questembert	ca. 316 Ma	(U)		Tartèse and Boulvais, 2010; Tartèse et al., 2013
		Guérande	ca. 310 Ma	U - Sn		Balloard et al., 2015
		Huelgat	Late Carboniferous	-		Georet, 1986
	Iberian massif	Brignogan	Late Carboniferous	-		Georet, 1986
		Ponte Segade	Late Carboniferous	Sn - Ta - Nb - Li - Be - Cs		Canosa et al., 2012
		Jalama	Late Carboniferous	Sn-W-(Nb-Ta)		Ramírez and Grundvig, 2000
		Beariz (Avion)	Late Carboniferous	-		Gloaguen, 2006
		Beariz	Late Carboniferous	Sn - W		Gloaguen, 2006
	French Massif Central	Boboraz	Late Carboniferous	-		Gloaguen, 2006
		Carballino	Late Carboniferous	Sn-W-(Nb-Ta)		Gloaguen, 2006
		Irixo	Late Carboniferous	-		Gloaguen, 2006
		Pedrobernardo	c.a. 300 Ma	-		Bea et al., 1994
		S. Mamede de Ribatua	Hercynian	Sn-W		Nieva, 2002
		Panasqueira	Hercynian	Sn-W		Nieva, 2002
Cornubian Batholith	Colette	ca. 310 Ma	-	Ta - Be - Sn - Li		Raimbault et al., 1995
		ca. 310 Ma	-			Raimbault et al., 1995
		ca. 350 Ma	-			Rolin et al., 2006
	Erzgebirge	-	295-275 Ma	Sn - W - (Cu)	Li - mica granites and greisens	Chappell and Hine, 2006; Müller et al., 2006
		-	Late Carboniferous - Early Permian	Sn - U - W		Förster et al., 1999; Breiter, 2012; Štemprok et al., 2005
	Fichtelgebirge	-	Late Carboniferous - Early Permian	?	?	Hecht et al., 1997
	Central Vosges	-	329 - 322 Ma	-		Tabaud et al., 2015
Nova Scotia - Canada	South Mountain Batholith	-	Late Devonian	-	Topaz muscovite leucogranites and greisens	MacDonald et al., 1992
		Davis Lake	Late Devonian	Sn		Dostal and Chatterjee, 1995
South Africa	Kaapvaal Craton	Lekkersmaak granite suite	ca. 2800 Ma	-		Jaguin, 2012
	Cape Granite Suite	Peninsula pluton	556-534 Ma	-		Farina et al., 2012
South China	Hunan Province	Indosinian granites	210 – 243 Ma	?	?	Wang et al., 2007
	Yunnan Province	Dulong granites	ca. 90 Ma	Sn		Xu et al., 2015
Indonesia	Belitung	Tanjungpandan pluton	ca. 215 Ma	Sn - W	Muscovite leucogranites (phase 2) Albite-amazonite Li-F granites (phase 3)	Schwartz and Surjono, 1990
Eastern Transbaikalia	-	Kukul'bei complex	ca. 140 Ma	W - Sn Ta		Zaraisky et al., 2009
Central Mongolia	-	Ongon Khairkhan	Ca. 120 Ma	W	Ongonites (topaz bearing albite-rich microleucogranites)	Dostal et al., 2015

Table DR1: Synthesis of the peraluminous granites reported in this study with their location, their age, their associated metal deposits when available and the corresponding references.

REFERENCES

- Ballouard C., Boulvais P., Poujol M., Gapais D., Yamato P., Tartèse R., Cuney M., 2015, Tectonic record, magmatic history and hydrothermal alteration in the Hercynian Guérande leucogranite, Armoricane Massif, France: *Lithos*, v. 220–223, 1–22, doi:10.1016/j.lithos.2015.01.027.
- Bea, F., Pereira, M.D., Corretgé, L.G., Fershtater, G.B., 1994, Differentiation of strongly peraluminous, perphosphorus granites: The pedrobernardo pluton, central Spain, *Geochimica et Cosmochimica Acta*: v. 58, 2609–2627, doi:10.1016/0016-7037(94)90132-5.
- Breiter, K., 2012, Nearly contemporaneous evolution of the A- and S-type fractionated granites in the Krušné hory/Erzgebirge Mts., Central Europe: *Lithos*, A-type granites and related rocks through time “International Conference on A-type Granites and Related Rocks through Time”, August 2010, Helsinki, Finland. 151, 105–121, doi:10.1016/j.lithos.2011.09.022.
- Canosa, F., Martin-Izard, A., Fuertes-Fuente, M., 2012, Evolved granitic systems as a source of rare-element deposits: The Ponte Segade case (Galicia, NW Spain): *Lithos*, Seventh Hutton Symposium on Granites and Related Rocks 153, 165–176, doi:10.1016/j.lithos.2012.06.029
- Chappell, B.W., Hine, R., 2006, The Cornubian Batholith: an Example of Magmatic Fractionation on a Crustal Scale: *Resource Geology*, v. 56, 203–244, doi:10.1111/j.1751-3928.2006.tb00281.x.
- Dostal, J., Chatterjee, A.K., 1995, Origin of topaz-bearing and related peraluminous granites of the Late Devonian Davis Lake pluton, Nova Scotia, Canada: crystal versus fluid fractionation: *Chemical Geology*, v. 123, 67–88, doi:10.1016/0009-2541(95)00047-P.
- Dostal, J., Kontak, D.J., Gerel, O., Gregory Shellnutt, J., Fayek, M., 2015, Cretaceous ongonites (topaz-bearing albite-rich microleucogranites) from Ongon Khairkhan, Central Mongolia: Products of extreme magmatic fractionation and pervasive metasomatic fluid: rock interaction: *Lithos*, v. 236–237, 173–189. doi:10.1016/j.lithos.2015.08.003.
- Farina, F., Stevens, G., Villaros, A., 2012, Multi-batch, incremental assembly of a dynamic magma chamber: the case of the Peninsula pluton granite (Cape Granite Suite, South Africa): *Mineralogy and Petrology*, v. 106, 193–216, doi:10.1007/s00710-012-0224-8.
- Förster, H.-J., Tischendorf, G., Trumbull, R.B., Gottesmann, B., 1999, Late-Collisional Granites in the Variscan Erzgebirge, Germany: *Journal of Petrology*, v. 40, 1613–1645, doi:10.1093/petroj/40.11.1613.
- Georget, Y., 1986, Nature et origine des granites peralumineux à cordiérite et des roches associées. Exemples des granitoides du Massif Armoricain (France): *Pétrologie et géochimie* [Ph.D. thesis] : Université Rennes 1, 298p.
- Gloaguen, E., 2006, Apports d'une étude intégrée sur les relations entre granites et minéralisations filoniennes (Au et Sn-W) en contexte tardiorogénique (Chaîne Hercynienne, Galice centrale, Espagne) [Ph.D. thesis] : Université d'Orléans, 574p.
- Hecht, L., Vigneresse, J.L., Morteani, G., 1997, Constraints on the origin of zonation of the granite complexes in the Fichtelgebirge (Germany and Czech Republic): evidence from a gravity and geochemical study: *Geol. Rundsch*, v. 86, S93–S109, doi:10.1007/PL00014669.
- Jaguin, J., 2012, Datation et caractérisation de processus minéralisateurs à l'Archéen : Application à l'Antimony Line, Ceinture de Roches Vertes de Murchison, Afrique du Sud [Ph.D. thesis] : Université Rennes 1, 350p.
- MacDonald, M.A., Home, R.J., Corey, M.C., Ham, L.J., 1992, An overview of recent bedrock mapping and follow-up petrological studies of the South Mountain Batholith, southwestern Nova Scotia, Canada: *Atlantic Geology*, v. 28.
- Müller, A., Seltmann, R., Halls, C., Siebel, W., Dulski, P., Jeffries, T., Spratt, J., Kronz, A., 2006, The magmatic evolution of the Land's End pluton, Cornwall, and associated pre-enrichment of metals: *Ore Geology Reviews*, v. 28, 329–367.
- Neiva, A.M.R., 2002, Portuguese granites associated with Sn-W and Au mineralizations: *Bulletin of the Geological Society of Finland*, v. 74, Parts 1–2, 79–101.

- Raimbault, L., Cuney, M., Azencott, C., Duthou, J.-L., Joron, J.L., 1995, Geochemical evidence for a multistage magmatic genesis of Ta-Sn-Li mineralization in the granite at Beauvoir, French Massif Central: *Economic Geology*, v. 90, 548–576. doi:10.2113/gsecongeo.90.3.548.
- Ramírez, J.A., Grundvig, S., 2000, Causes of geochemical diversity in peraluminous granitic plutons: the Jálama pluton, Central-Iberian Zone (Spain and Portugal): *Lithos*, v. 50, 171–190, doi:10.1016/S0024-4937(99)00047-X.
- Rolin, P., Cartannaz, C., Henry, P., Rossy, M., Cocherie, A., Salen, F., Delwaulle, B., Mauroux, B., 2006, Notice explicative, *Carte géologique de la France*, échelle : 1/50 000, feuille Saint-Sulpice-les-Champs (666), Orléans : BRGM, 178 p.
- Schwartz, M.O., Surjono, 1990, Greisenization and albitization at the Tikus tin-tungsten deposit, Belitung, Indonesia: *Economic Geology*, v. 85, 691–713, doi:10.2113/gsecongeo.85.4.691.
- Štemprok, M., Pivec, E., & Langrová, A., 2005, The petrogenesis of a wolframite-bearing greisen in the Vykmanov granite stock, Western Krušné hory pluton (Czech Republic): *Bulletin of Geosciences*, v. 80(3), 163–184.
- Tabaud, A.-S., Janouek, V., Skrzypek, E., Schulmann, K., Rossi, P., Whitechurch, H., Guerrot, C., Paquette, J.-L., 2015, Chronology, petrogenesis and heat sources for successive Carboniferous magmatic events in the Southern-Central Variscan Vosges Mts (NE France): *Journal of the Geological Society*, v. 172, 87–102. doi:10.1144/jgs2013-12
- Tartèse, R., Boulvais, P., 2010, Differentiation of peraluminous leucogranites “en route” to the surface: *Lithos*, v. 114, 353–368, doi:10.1016/j.lithos.2009.09.011.
- Tartèse, R., Boulvais, P., Poujol, M., Gloaguen, E., Cuney, M., 2013, Uranium Mobilization from the Variscan Questembert Syntectonic Granite During Fluid-Rock Interaction at Depth: *Economic Geology*, v. 108, 379–386. doi:10.2113/econgeo.108.2.379
- Wang, Y., Fan, W., Sun, M., Liang, X., Zhang, Y., Peng, T., 2007, Geochronological, geochemical and geothermal constraints on petrogenesis of the Indosinian peraluminous granites in the South China Block: A case study in the Hunan Province: *Lithos*, v. 96, 475–502, doi:10.1016/j.lithos.2006.11.010.
- Xu, B., Jiang, S.-Y., Wang, R., Ma, L., Zhao, K., Yan, X., 2015, Late Cretaceous granites from the giant Dulong Sn-polymetallic ore district in Yunnan Province, South China: Geochronology, geochemistry, mineral chemistry and Nd–Hf isotopic compositions: *Lithos*, v. 218–219, 54–72. doi:10.1016/j.lithos.2015.01.004.
- Zaraisky, G.P., Aksyuk, A.M., Devyatova, V.N., Udrovatina, O.V., Chevychelov, V.Y., 2009, The Zr/Hf ratio as a fractionation indicator of rare-metal granites: *Petrology*, v. 17, 25–45, doi:10.1134/S0869591109010020.