Late Palaeozoic to Mesozoic gold-bearing ore deposits from Cornwall to Jiaodong - a plate-tectonic perspective for plutono-metasomatic systems

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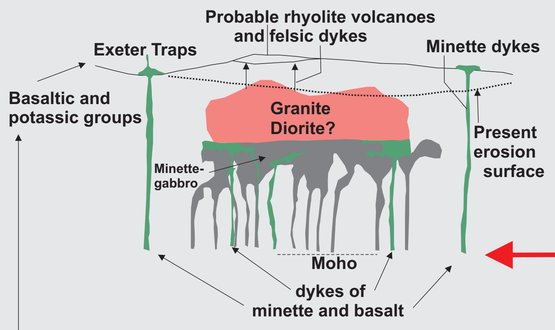
"Mountain complexes result from irregular successions of tectonic responses due to sea-floor spreading, shifting lithosphere plates, transform faults, and colliding, coupled, and uncoupled continental margins" (Coney, 1970).

CERCAMS - 16 'One billion years of crustal growth from Altaids to SW Pacific', London, 26-28 October 2016.

Fig. 2 Schematic N-S section across the post-Variscan Cornubian batholith and Exeter Traps, SW England, and their Sn-Cu-dominated ores (modified from Leat et al., 1987).

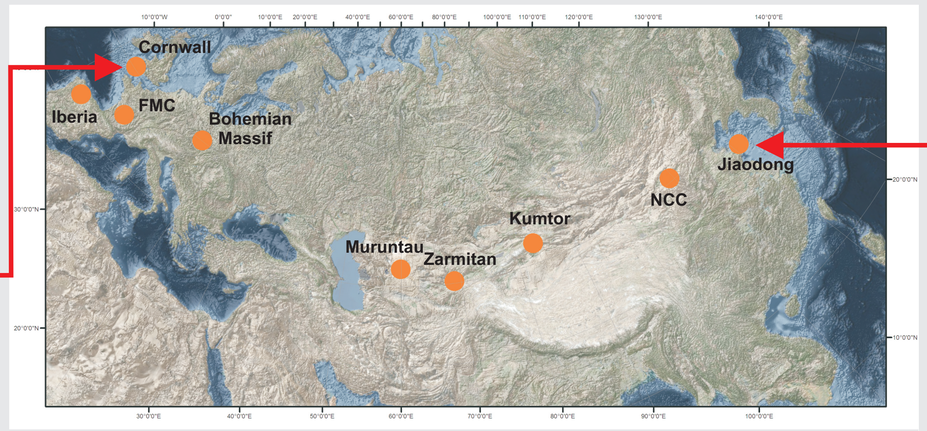


Emplacement of the complex, incuding its W-As-Sn-Cu-Zn ores, from c. 295 to c. 270 Ma (Shail et al., 2003).

Chemistry suggests subduction-related magmas, albeit emplaced at the time of oceanic slab detachment (Stampfli et al., 2013) and deep strike-slip deformation.

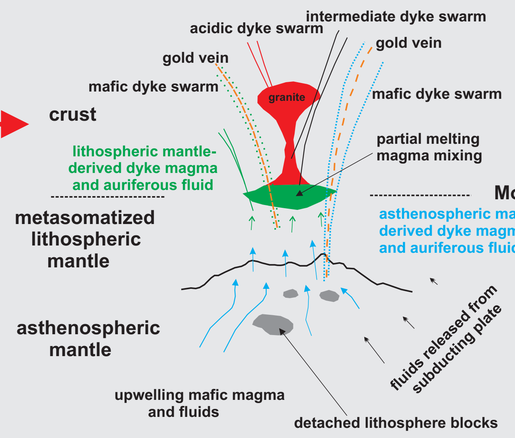
- Leat et al. - sourced in asthenosphere and enriched subcontinental lithosphere, respectively ?

Fig. 1 Distribution of prominent Late Palaeozoic to Mesozoic ore districts. FMC - French Massif Central, NCC - northern margin of North China Craton.



Comparable models

Fig. 3 Formation of intermediate-mafic dykes and relation to their Au-dominated ores in the Jiaodong Province, E China, (modified from Li et al., 2016).



Compare Fig. 2 - 'Thirty years on'.

- **Approximately coeval gold deposits in western Europe and central Asia.**
- **Associated metals overlooked.**
- **Intracontinental setting.**

Considerations

- In western Europe, most dated gold deposits in the Palaeozoic crystalline massifs show a formation peak between 303 and 290 Ma.
- In western and central Asia, prominently endowed deposits in the South Tianshan show a peak between 288 and 284 Ma.
- Interest in gold has grossly overshadowed associated assemblages and coeval deposits of W, Sn, Cu, Sb, Hg, Ag, Zn, Ni, Co, Mo, U.
- Similarity of assemblages, in the same provinces: common sources and processes in a common geodynamic setting.
- Insistence on gold's orogenic affiliations has minimised a plate tectonic dependence.

Framework

Variscides-Tianshan

- loss of crustal or lithospheric root(s)?, slab break-off, slab roll-back;
- uplift, decompression, collapse; asthenosphere upwelling; Large and Scattered Igneous Provinces;
- (oblique) subduction of Palaeotethys had ceased at the time of ore formation;
- suture belts dissected by translithospheric, transcurrent fault zones.

Yinshan - Yanshan

- Late Jurassic to Early Cretaceous intracontinental belt of uplifted Precambrian blocks hosting multiple gold deposits on the northern margin of th NCC, south of the Palaeozoic Solonker suture;
- Nature of Yanshan orogeny uncertain: thermo-tectonic event (Pirajno, 2013), strike-slip orogen (Faure et al., 2012).

Jiaodong

- hosted by North China Craton, associated Jurassic-Cretaceous Yanshanian orogeny (Groves & Santosh, 2015); no regional metamorphism (Shao et al. 2007);
- partial loss of craton root; Scattered Igneous Province;
- uplift, decompression, collapse; asthenosphere upwelling;
- oblique Palaeo-Pacific subduction, presently flat, stalled? slab;
- translithospheric, transcurrent faults.

- Yanshanian orogenesis? = thermo-tectonic event?, strike-slip orogen? or both? or what? No regional metamorphism (Shao et al. 2007).
- Interaction between North China Craton root and Pacific slab?

Translithospheric physico-chemical reactors

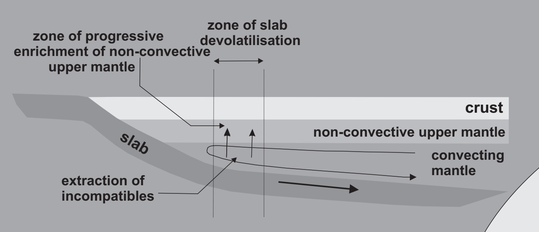


Fig. 4 Upper mantle fertilisation, after Hronsky et al. (2012).

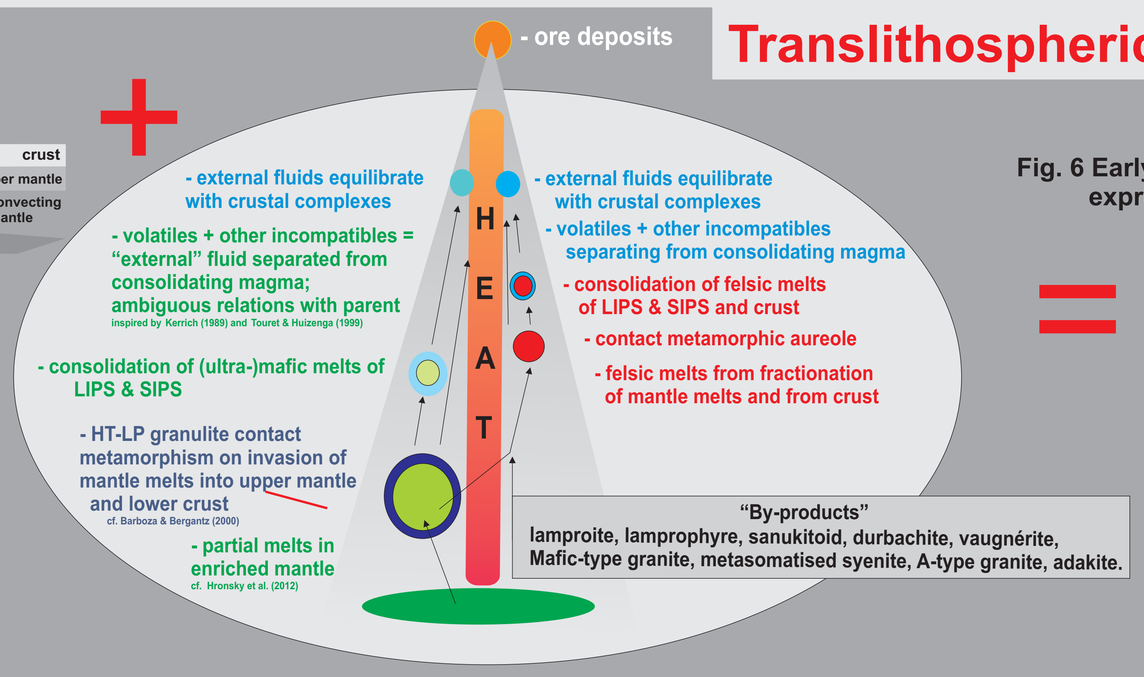
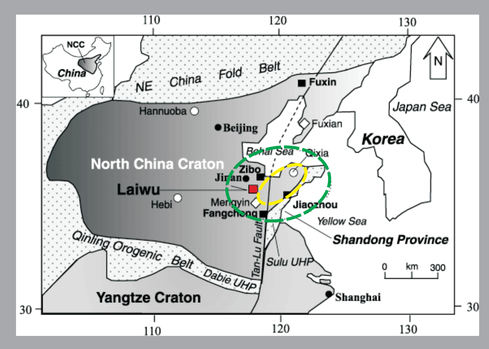


Fig. 5 Plutono-metasomatic complexes, emerging from enriched mantle, accessed by translithospheric fault zones, on reaction with the lithosphere, modified from De Boorder 2012, 2014, 2015; compare Seifert 2008; Ord et al. 2016).

Fig. 6 Early Cretaceous Jiaodong gold province, Eastern Chin expression of a plutono-metasomatic complex



Early Cretaceous Jiaodong gold province (yellow), across the Tan-Lu Fault, overlain by Cenozoic Shandong igneous province (green) with Early Cretaceous subduction-metasomatised xenoliths (modified from Chen & Zhou, 2005).

• Suggestion (1)

• Challenges

- Distance between the ore deposits and consolidating melts in cases where igneous rocks seem to be rare or missing.
- How far can exsolved volatiles/fluids travel as a flux?

• Suggestion (2)

- **Since the ore deposits are hosted by different types of orogen, if at all, they transpire as a direct function of the lithosphere plates rather than of anyone orogen.**
- Is Jiaodong the archetype of 'mesothermal', 'mesozonal', 'hypozonal' and 'orogenic' gold and associated ore deposits, applicable all the way back to Cornwall?
- Sources and engines are in the mantle and availability of incompatible metals for ore deposits depends on structural access to enriched domains.
- Exploration needs to take account of the migration and the deep configurations of the lithosphere plates.

• References

Barboza & Bergantz (2000) http://dx.doi.org/10.1093/petrology/41.8.1307 ; Cawood et al. (2009), Geol.Soc.Lon.Spec.Publ. 318, 1-36; Chen & Zhou (2005) http://dx.doi.org/10.1029/2005GC000938; Coney (1970) Geol.Soc.Am.Bull. 81, 739-748; De Boorder (2012) http://dx.doi.org/10.1016/j.oregeorev.2012.01.002; (2014) http://dx.doi.org/10.1127/0163-3171/2013/0008; (2015) http://dx.doi.org/10.1016/j.oregeorev.2014.04.007; Faure et al. (2012), http://dx.doi.org/10.1111/ter.12002; Groves & Santosh (2015) http://dx.doi.org/10.1016/j.gsf.2015.08.002, Hronsky et al. (2012) http://dx.doi.org/10.1007/s00126-012-0402-y; Kerrich (1989) http://dx.doi.org/10.1130/0091-7613(1989)017<1011:AGRTGF>2.3.CO;2 ; Leat et al. (1987) Trans. Roy. Soc. Edinburgh 77, 349-360; Li et al. (2016) http://dx.doi.org/10.1016/j.jseaes.2016.06.015; Ord et al. (2016) http://dx.doi.org/10.1016/j.oregeorev.2016.03.026; Pirajno (2013) http://dx.doi.org/10.1007/978-94-007-4444-8, p. 28; Shail et al. (2003) http://dx.doi.org/10.1179/037174503225001712; Shao et al. (2007), Geol.Soc.Lon.Spec.Publ. 280, 189-200; Stampfli et al. (2013) http://dx.doi.org/10.1016/j.tecto.2013.02.037 ; Touret & Huizenga (2009) J.Afr.Earth Sci. 28, 67-382.