Vein-hosted Copper Deposits and Hydrothermal Processes of SW Ireland

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INTRODUCTION

This study focuses on the historically mined vein-hosted copper deposits in southwest Ireland. Central to this is determining the role of Upper Palaeozoic Munster and South Munster Basin structural architecture on the nature and timing of mineralisation. Aerial image interpretation and field studies revealed large scale, basin related E-W to SW-NE striking extensional faults (Fig. 1). These extensional faults are associated with copper bearing quartz veins and large N-S striking (transfer?) mineralised sediment beds floor the Variscan strike (SW-NE). They occur in proximal distance to E-W striking faults and mineralised quartz veins.

ACKNOWLEDGEMENTS/REFERENCES

We wish to thank the Mines Department for allowing us access to the mining literature and archives of the Irish Mining Institute for allowing us access to the mining literature and archives of the Irish Mining Institute. This research was supported in part by a research grant from Science Foundation Ireland (SFI) under Grant 13/IA/1792. The publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under Grant 13/IA/1792. The publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under Grant 13/IA/1792.

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Acknowledgements

The authors acknowledge the financial support of the Irish Centre for Research in Applied Geosciences (iCRAG), the School of Biological, Earth and Environmental Sciences, University College Cork, Ireland.

Fig. 2 Structural Map of the historic copper mines at Athlone, Ballycumisk. Pre-Variscan, extensional faults and mineralised veins (striking mainly E-W) are affected by syn-Variscan, SW-NE striking structures (dotted maps and Bing™ Satellite Maps, 2020), including field analysis and modifications from Kelly (1986).

a) Major lodes of the Mountain Mine Area with pre- and syn-deformation structures.
b) Detailed faulted lode of Great Mountain Mine (WM of Mountain Mine Area).
c) Detailed faulting of Coon Lodge (SE of Mountain Mine).
d) Historic sample of mineralised quartz vein with molybdenite and minor chalcopyrite from National History Museum London (NHM, Russell collection, 1919).

366.4 ± 1.9 Ma

GORTAVALLIG

Fig. 3 Map of the Historic copper mines at Gortavallig, Sheep’s Head (including high resolution drone imagery and ArcGIS® BaseMap, 2019). The copper bearing quartz veins were faulted E-W striking extensional faults. The major extensional fault shows a sinistral offset (121 m) caused by a high angle, syn-Variscan reverse fault (SW-NE striking).

Fig. 4) The copper mines of Crookhaven are located on the southern coast of Ballycumisk.

a) Drone imaging (including ArcGIS® BaseMap, 2019) and field data show a WSW-ENE strike of the pre-Variscan extensional faults and the associated mineralised quartz veins. This pre-Variscan strike is parallel to the syn-Variscan structures (folds and faults).
b) A set of smaller mineralised (chalcopyrite) quartz veins occur sub-horizontal within altered践行. Variscan compression from 1E- 6N NW caused small scale folding and shearing.

311.8 ± 1.6 & 315.5 ± 1.6 Ma

BALLYCUMISK

Fig. 5) Comparable with Crookhaven, the copper lodes at Ballycumisk strike WSW-ENE (SO azimuth).

A historic molybdenite sample from NHM (Russell collection, 1907) and a recent finding from the Ballycumisk dumps show Re-Os times of 311.8 ± 1.6 Ma and 315.5 ± 1.6 Ma.

Mineralised copper minerals, within the mineralised quartz vein sample, indicate a post-remobilisation (Variscan) compressional event.

Fig. 6) Copper is an essential product for sustainable, environmentally friendly and modern techniques. Several hundred kilograms of copper were mined over the production of 19.45 Mt of ore. Copper has a high electrical conductivity and is therefore used in almost every electrical device (smartphones, computers, flat screens). The key components of wind turbines are large copper coils which produce sustainable electrical energy.

Fig. 7 Results/Hypothesis

The North-South extension during the development of the Munster and the South Munster Basins caused large scale E-W striking extensional faults which provided a deep sourcing fluid pathway for medium to high saline copper rich fluids (Fig. 7a). These fluids formed the mineralised, mainly E-W striking and steep dipping quartz veins.

The end Carboniferous Variscan Orogeny deformed, faulted and folded the basin structures as well as the mineralised veins and remobilised silica-rich fluids, which precipitated quartz veins into tension gashes (saddle reef), echelon veins, sub-horizontal (wedgefold) (Fig. 7b).