

Technical Memorandum

To: Bart Jaworski **At:** GERC
From: John Kelly **At:** SLR Belfast/Dublin
Date: 24th April 2019 **Ref:** 501.00415.00001
Subject: DRILLHOLE G11-450-02 REVIEW

Bart,

See below findings from the review of the drillcore etc. from drillhole G11-450-02.

Stratigraphy

Ballysteen Limestone Formation

With the exception of the presence of an igneous intrusive from 482.3 to 497.1m, the Ballysteen Sequence intersected is typical of this formation and shows nothing of interest.

Waulsortian

Lithologies attributable to the Waulsortian Complex are intersected between 307.3m to the base of Waulsortian at 430.3m. The top of the complex is marked by an interval of Waulsortian Equivalent facies between 307.3 to 309.7m, overlying an interval of cherts present between 309.7m and 325.0m. Volcanic breccia intervals, presumably intrusives, are present within the Waulsortian between 359.4 – 364.6m and 378.0 to 393.8m

The Waulsortian is extensively brecciated with many of the brecciated intervals reminiscent of typical Pallas Green – Rathdowney Trend – Silvermines hydrothermal alteration breccias, although some of the brecciation may be related to volcanicogenic fluids related to the intrusive intervals.

The top and base of the chert interval appear to be conformable.

Supra-Waulsortian Sequence

The immediate Supra-Waulsortian sequence from 214.2 to 307.3m of a mixed carbonate/volcanic sequence comprising dark grey to black cherts with interbedded tuffs, volcanic breccias, volcaniclastics and argillaceous bioclastic limestones attributable to the Lough Gur Formation.

These are overlain by volcaniclastics with interbedded argillaceous bioclastic limestones attributable to the Lough Gur Formation and Knockroe Volcanics which are in turn overlain by a thin interval of oolitic grainstones typical of the Herbertstown Formation. This thin grainstone interval is then overlain by a sequence of intrusives, intensely altered volcanic breccias which may represent phreatic explosion

breccias and finally a sequence of sub-aerial lava flows with weathered (lithomarge) flow tops clearly definable. This upper sequence is probably equivalent to the Knockseefin Volcanic Formation.

Alteration and Mineralization

Supra-Waulsortian Sequence

In the immediate Supra-Waulsortian, pyrite extensively replaces the carbonate component of laminated mudstones and the matrix in siliceous micro-conglomerates and the rims of the silica clasts.

In the rest of the Supra-Waulsortian sequence, mineralization typically consists of widespread disseminated and clast rim replacive iron sulphides in the cherts and limestones, with pyritic replacement and semi-massive pyrite bands present in the tuffs. The sequence containing pyrite extends up to approximately 100m above the top of the Waulsortian.

Waulsortian

The Waulsortian limestone sequence and the volcanic intrusive intervals are extensively brecciated and assay data show consistently elevated levels of Fe and S (typical Waulsortian S levels are <0.1%) within these intervals indicating the presence of pervasive pyritization, with locally pyrite-rich intervals.

Many of the breccia textures within the Waulsortian are similar in appearance to base-metal associated hydrothermal breccias associated with the Rathdowney and Silvermines orebodies and the Pallas Green deposits.

Summary

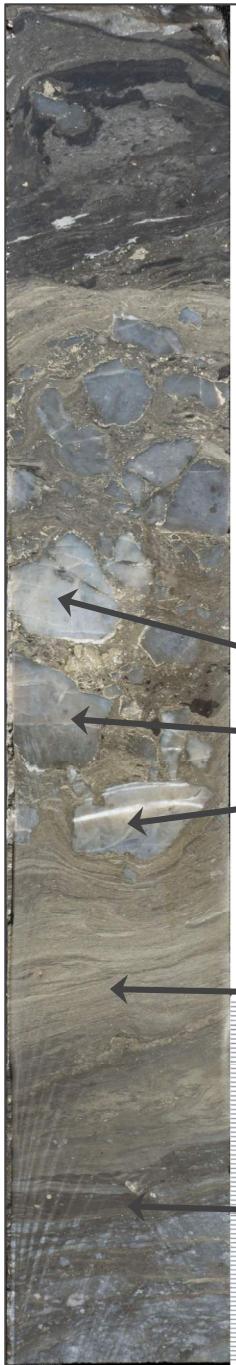
- The sequence intersected is typical of a mixed southwest Ireland Carboniferous Carbonate – Limerick Volcanic sequence with the exception of the dark grey to black chert intervals in the upper part of the Waulsortian and the immediate supra-Waulsortian sequence where the typical immediate Supra-Waulsortian Knockroe Volcanic sequence of volcanics and lavas does not typically include volcanogenic cherts.
- The cherts present are generally conformable with the rest of the sequence and contain interbedded tuff horizons or limestones, with conformable contacts.
- The cherts are therefore here interpreted as volcanogenic cherts, representing an unusual (for Limerick) mixed volcanogenic chert/volcaniclastic-tuff/carbonate sediment package deposited during the onset of volcanism in the area.
 - It has been suggested that the extensive dark grey to black cherts in the upper part of the Waulsortian and the Supra-Waulsortian sequence may be hydrothermal alteration cherts. This is considered highly unlikely as there is no evidence that these cherts are replacing a previous lithology as there is no relict lithology present and the cherts are intimately interbedded with volcanics/tuffs. Bioclasts present are more likely to represent background seafloor biota.

- It has also been suggested that the cherts may be replacing black mudstones, but thick black mudstones are unknown in this stratigraphic interval and no relict mudstone is present.
- The extensive brecciation and pyritization in the Waulsortian in conjunction with the extensive pyrite in the Supra-Waulsortian indicates that the sequence has been extensively hydrothermally altered and the vertical extent of the alteration indicates that the hydrothermal system is substantial in scale.
 - The presence of colloform sulfides is indicative of the presence of biogenic activity and the likely presence of biogenic sulfur, critical to the development of Irish orebodies.
 - The extensive Waulsortian brecciation and abundant pyrite, if not volcanic related, indicates significant interaction of the sequence with deep hydrothermal fluids.
- The presence of breccias/conglomerates with abundant pyrite clasts (e.g. 204.0 to 206.5m approx.) suggests reworking of sulfides formed immediately prior to this interval.
- The absence of less mobile base-metals (Zn, Pb, Cu) indicates that the drillhole has intersected the distal portion of the hydrothermal system and therefore appears to be distal to the core of the hydrothermal system where the bulk of the base metals are likely to be concentrated.
- Irish southern Midlands/Limerick Province hydrothermal mineralization systems are typically pyrite rich and strongly metal zoned both laterally and vertically, with Fe sulphides dominating the sulphides in the laterally distal and vertically uppermost parts of the system, which becomes increasingly Zn and then Pb rich proximal to the hydrothermal fluid source points (system cores).

Yours sincerely
SLR Consulting Limited



EurGeol Dr. John G. Kelly, PGeo, MIMMM, MIQ
 Technical Director



- Silica (volcanogenic chert?) pebbles showing drop stone like indentation into Supra-Waulsortian laminated mudstones. Matrix strongly pyritised and pyrite replacement rims on clasts
- Immediate Supra-Waulsortian associated laminated calcareous mudstones extensively replaced by pyrite
- Top of Waulsortian associated limestones

G11-450-02 307.0 to 307.4m

Appears to show erosion and deposition of volcanogenic silica into unlithified mudstones on immediate top of Waulsortian sequence. Strong pyritic alteration of mudstones and silica clast rims post-deposition.



G11-450-02 183.2 to 191.0m
Interbedded cherts and volcaniclastics/tuffs.



G11-450-02 211.3 to 220.0m
Interbedded cherts and tuffs with pyrite bands



G11-450-02 213.2m
Detail of colloform pyrite in tuff horizon



G11-450-02 345.3 to 350.0m.
Hydrothermal breccias in Waulsortian.



G11-450-02 370.5 to 376.4m.
Hydrothermal breccias in Waulsortian.