Sediment- Hosted Lead - Zinc Deposits The Existence In Indonesia

S. Digdowirogo (PT. Sumagud Sapta Sinar), S. Prihatmoko (PT. Austindo Mining Corporation) and H. Lubis (PT. Sumagud Sapta Sinar)

Background

The best known Pb-Zn- (Au-Ag) deposits and occurrences in Indonesia such as Gunung Limbung – West Java, Tanjung Balit – Riau and Paleleh – North Sulawesi are believed to be epigenetic or intrusive- related and chiefly hosted by volcanics and intrusives. None of them is of economic interest, and this deposit type makes an insignificant contribution to the world Pb-Zn reserves. By contrast, the sediment- hosted Pb-Zn-Ag deposits play an important role as they contribute more than two third of world Pb-Zn reserves (Singer, 1995).

Sedex, which is one class of the sediment-hosted Pb-Zn-Ag deposits, has recently been identified in the Herald Resources Ltd – PT Aneka Tambang Persero (Tbk) joint venture area, in the Sopokomil prospect, Dairi, North Sumatra during a drilling campaign. The sediment-hosted Pb-Zn deposit has actually been defined in Kelapa Kampit, Belitung.

Sedex: Distribution and Genesis

Sedex is an acronym for sedimentary exhalative, a term introduced by Carne and Cathro (1982) for deposits in the Selwyn basin, Canada that they interpreted as forming by the exhalation of metal-laden brines onto the floor of anoxic sub-basins. This genetic term is created to distinguish it from the volcanic exhalative or VMS (volcanogenic massive sulphides). Both types are supposed to be syngenetic but sedex is interpreted to be a distal precipitation and therefore lacking volcanics. Some sedex deposits have recently been reinterpreted as syndiagenetic replacement origin which makes them epigenetic (Large et al., 1998) and to avoid confusion some writers have proposed a descriptive classification. Consequently sedex has been classified into one of the four sediment-hosted Pb-Zn-Ag type deposits and renamed the stratiform shale – hosted deposit. The other three types of deposits are Mississippi Valley type (MVT), Irish – style and Broken Hill type (BHT). Unlike sedex deposits which form layered or stratiform sulphide sheets interbedded with reduced clastic sediments - mostly shale and siltstone, MVT deposits tend to be stratabound in limestone and dolomite and deposited after the host rocks have lithified and do not show the iron sulphide halo so typical of many sedex deposits. Hence they mostly have lower iron sulphides and also lower Ag content compared with other types. Irish – style deposits show some combination features between the sedex and the MVT deposits. The BHT deposits differ from the sedex deposits because their hosts are oxidised sedimentary facies interbedded with metasediments of medium to high grades of metamorphism (Gustafson and Williams, 1981; Large, 1996; Sangster, 1996).

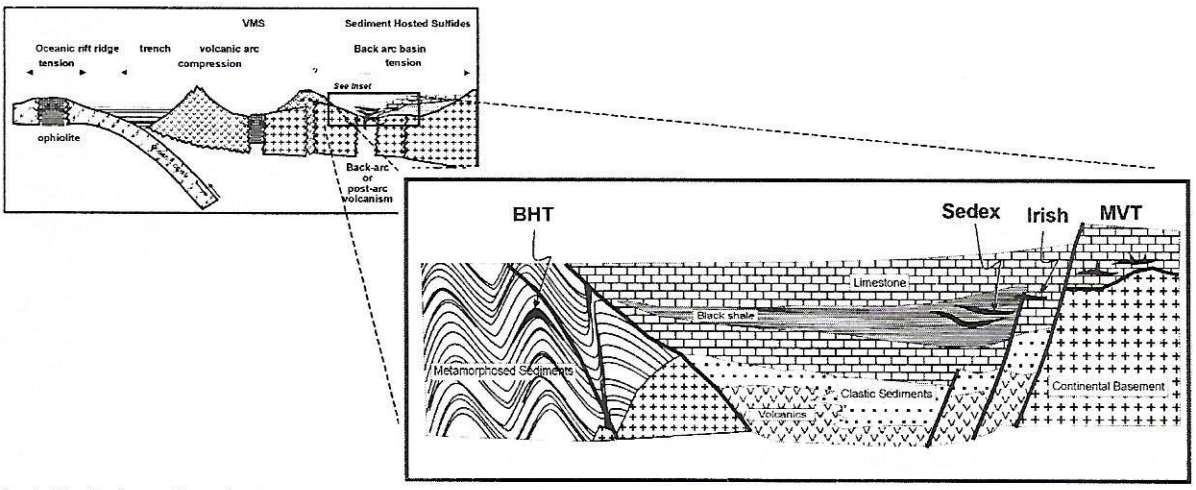


Fig 1: Tectonic and geological setting of sediment-hosted base metal sulphides (simplified from Hutchinson, 1980 and Large, 1996).

The sedex deposits were known originally from Australia and Germany. However important new discoveries and the redefinition of previously known deposits in Canada, Alaska, Ireland, Scotland, South America, South Africa, South West Africa, India and the former USSR have considerably enlarged the geographical distribution of these deposits, which now turn into 60 in total. The age of the host rocks varies, from Early Proterozoic to Jurassic and distribution peaks occur in Middle Proterozoic, Cambrian, and Devonian – Carboniferous (Large, 1996).

The sedex deposit has no igneous intrusive association, apart from the basic intrusions that commonly occur in the lower stratigraphy or rift package of the basin. Most workers therefore argue that connate brines derived from the underlying rift fill are responsible for sedex mineralization. Lithologies contained within the basin, together with the type of sedimentary basin from which the fluids are derived, control the chemistry of the mineralizing brines which form two main classes: sulphate predominant (oxidized brines) and sulphide predominant (reduced, acid brines). These are also important for controlling minor element associations. The oxidized brines can precipitate siderite or ferroan carbonate and form halos such as observed in the deposits hosted by the McArthur basin (180,000 sq km) and the Mount Isa basin (70,000 sq km), in central northern Australia. The thickness of the underlying sediments in each basin is at least 6,500 meters and consists of carbonates, evaporites and haematitic sandstones and shales. Basalts are also an important rock type. In contrast, the reduced, acid brines are capable of transporting minor elements such as Ba, Au and Sn, which have been detected in the deposits in the Selwyn basin, Canada of which the underlying sediment fill comprises reduced siliciclastics rich in feldspar and shales (Cooke et al., 2000).

Despite the ambiguity about the accumulation of sedex deposits, whether from precipitation of hydrothermal fluids on the sea floor or forming epigenetically from mineralizing solution, the deposits are interpreted to have been precipitated in anoxic and fairly deep water environments, typically more than 150 m in marine setting or deeper than many tens of meter in lake environments (Winn et al., 1987; Large et al., 1998). Their tectonic setting is in tectonically active intracratonic rifts or continental margin marine basins. Within these large-scale basins the deposits are commonly found in fault-controlled sub-basins. Their setting is illustrated in Figure 1. A typical cycle of geological event in the formation of the significant HYC deposit (Here's Your Chance - containing 227 million tonnes @ 4.1 % Pb, 9.2 % Zn and 40.0 g/t Ag) in the McArthur basin is proposed by Large et al. (1998): fault movement, sediment breccia deposition, episodic release of hot metalliferous brines along faults accompanied by deposition of sedimentary turbidites, and metal sulphide deposition in the muds and turbidites adjacent to faults. The introduction of metalliferous brines into the basin was not continuous but occurred as a series of pulses interspersed with pelagic sedimentation and turbidite deposition.

Indonesia: the Sediment-Hosted Pb-Zn Deposits

There are two sediment-hosted Pb-Zn deposits that have been reported so far.

Kelapa Kampit, Belitung: The stratabound sediment hosted tin deposit refers to the presence of bedding plane-lodes cut by fissure / faults veins, which have been mined out. The deposit containing 0.35 million tonnes @ 1.5 % Sn is hosted by a horizon called Nam Salu which is part of a sequence of Carboniferous to Early Permian metamorphosed sandstone, siltstone, chert, volcanics and phyllite. The horizon has been traced for 3 km in strike length and 35 m in thickness and is composed of stilpnomelane, chlorite and phyllite. The chemically reactive layers are within the phyllite (metamorphosed claystone or ash tuffs) and at the contact between phyllite and more competent rocks such as metamorphosed sandstone or chert. The nearest granite outcrops are 30 km to the west and 20 km to the southeast from Kelapa Kampit and these are unlikely to have been responsible for the mineralization. Despite of unavailable gravimetric data, an underlying granite is suggested the appropriate source of mineralization (Schwartz and Suryono, 1990). Within the Nam Salu horizon, a few kilometres away from the abandoned open pit tin mine, marginal Pb-Zn deposits are present as bedding plane- lodes and fault –filling. The enrichment of Pb-Zn occurred when the syngenetic favourable horizon was intersected by the fault veins (Nitiwisastro, pers com., 2000).

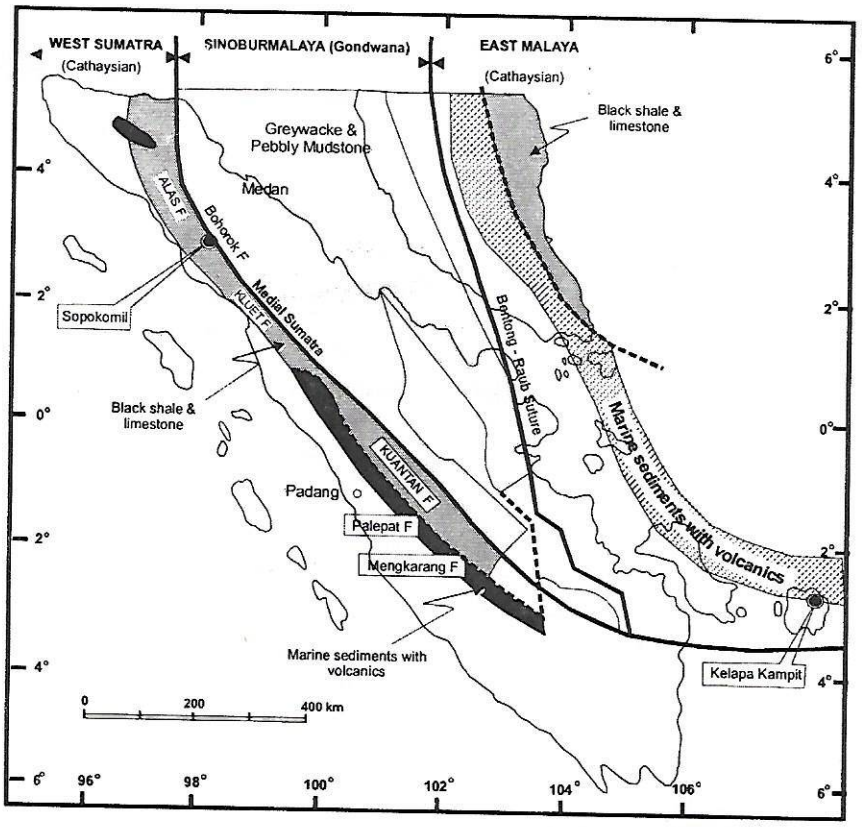


Fig 2: Pre-Tertiary basement of Sundaland: Carboniferous – Permian formations (simplified from Hutchinson, 1980)

Sopokomil, Dairi, North Sumatra: Sedex-type Zn-Pb massive sulphides were identified in late 1997 and their scattered outcrops have been traced over 2.8 km. The sedex zone is hosted by carbonaceous shale, in a mixed calc argillite and of Carboniferous age. Moreover MVT sphalerite mineralization, usually as a breccia cement but occasionally vein-bound with silver-bearing galena and tetrahedrite, occurs in a 90 m thick massive dolomitized limestone, which forms the footwall to the shale. This vein style of mineralization may be feeders for the sedex sulphides and part of the same mineralizating event. One of the drill holes intercepted 17.3 meters @ 12.3 % Pb, 18.5 % Zn and 19.0 g/t Ag (Herald Resources Ltd., 1999; IAX, 2000).

Discussion and Recommendation

Although the genetic model of the Kelapa Kampit deposit remains debatable and limited geological data in the Sopokomil sedex and MVT mineralization are available at the present stage, both sediment-hosted Pb-Zn deposits lie in the Pre-Tertiary formations: the East Malaya Block and the West Sumatra Block respectively. Within the West Sumatra Block, the Carboniferous-Permian formations to the southwest of the Medial Sumatra have been juxtaposed against the Sinoburmalaya terrain by wrench faulting and further southwest is bounded by the Sumatra Fault (Hutchison, 1996). However, Cameron et al (1980) interpreted that the relationship is interfingering. The tectonic setting is summarized in Figure 2.

The Tapanuli Group comprising the Bohorok, the Kluet and the Alas Formations and its correlable sequences such as the Kuantan, the Palepat, and the Mengkarang Formations to the southwest have now attracted attention. So has the East Malaya Block hosting the Kelapa Kampit sediment- hosted Pb-Zn deposits. All Pb-Zn occurrences in the Pre-Tertiary formations now need reviewing, particularly the regional and local host lithologies, and the thickness of the underlying sequence as well as their mode of occurrence and their tectonic setting and environment. From the exploration point of view, these deposits are supposed to be in window of outcrops beneath the Tertiary cover and indicates there may be potential to discover not only more of these types of deposit but, with the maturing of exploration in the terrain, the mineralization under cover. Exploration under cover is feasible proved by the discovery of the Cannington sediment- hosted deposit (now being mined – containing 47 million tonnes @ 10.7 % Pb, 4.6 % Zn and 470.0 g/t Ag), which is covered by a 60 m thick Cretaceous mudstone in the Mount Isa basin (Skrzeczynski, 1996).

Furthermore the Tertiary sediments, particularly in the extensional basins with several thousand meters thickness of marine sediment fill may also contain targets. These are suggested by the identification of the Palaeocene sediment-hosted Zn-Pb-Sr deposit in Jinding, Yunnan, China (Li et al, 1995) and by the fact that in many sedimentary basins mineralization is not confined to one time or horizon. For example a 7 my time span of mineralization has been documented in the Selwyn basin (Paradis et al, 1998).

Finally geoscientists who work in oil & gas and coal field areas are recommended to record " any strange looking stuff " such as sphalerite which may vary in colour from creamy white to black, galena, chalcopyrite, tetrahedrite, and other sulphides and their minor associated minerals such as siderite, barite, and other ferroan carbonate. Minor elements such as Mn, Au, Sn, Cd, Ag, Fe, As, may also indicate significant Pb-Zn mineralization. This will contribute to developing the wealth of mineral resources in Indonesia.

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