Ceramah Teknik (Technical Talk)

Behaviour of gold and other heavy minerals in streams — Implications for exploration geochemistry

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Laporan (Report)

Professor W.K. Fletcher gave the above talk at the Geological Survey Office in Kota Kinabalu on 3 February, 1994.

The talk was attended by an audience of 28 from the Geological Survey, Sabah Operations Centre and from exploration companies currently active in Sabah. The talk was lively and lucid and attracted some good questions from the floor.

Abstrak (Abstract)

Geochemical anomalies for gold in drainage sediments are typically erratic, both locally on the bed of the stream and seasonally. In part, this is a consequence of the rarity of gold particles leading to the so called nugget effect. However, even when care is taken to collect samples of sufficient size to be representative gold concentrations may still show considerable variability as a result of the variable transport and deposition of sediment and gold in response to local hydraulic conditions.

Field studies in Harris Creek, a small gravel bed stream in British Columbia, Canada, have shown that gold is preferentially accumulated at high energy bar-head sites as the annual flood, caused by melting snow, passes. The gold anomaly at such sites may remain constant or even show increasing concentrations downstream away from the source of the gold. In contrast, there is no preferential enrichment of gold at low energy bar-tail sites. Gold anomalies at such sites therefore have lower concentration of gold with values that decrease going downstream. The degree of enrichment of gold concentrations between high and low energy sites decreases as the size of the gold particles decreases.

Similar observations have been made for distribution of gold in a small stream in northern Thailand and for other heavy minerals elsewhere, for example cassiterite in Malaysia. Furthermore it has been shown that the field observations of the distribution of gold and other heavy minerals on the stream bed are consistent with the theoretical predictions of bed load transport models. Such models predict that preferential accumulation of gold will be favoured by high bed roughness and decreasing stream gradient.

The field observations and theory have important implications for the design and interpretation of stream sediment surveys for gold.

1. Because gold concentrations are greatest and anomalous dispersion trains longest in the high energy environment, such sites are to be preferred for low density reconnaissance surveys. However, care must be taken to obtain samples from sufficient depth in the bed of the stream to obtain gold-rich sediments deposited during flood events. Also concentrations of gold at such site may decrease (rather than increase) toward the bedrock source of the gold. Care is therefore required for interpretation and follow-up.
2. Gold concentrations at low energy sites are relatively low and the anomalous dispersions trains short. However, because concentrations of gold are more likely to increase upstream towards the source, they may provide a more suitable medium for follow-up or detailed surveys.
3. Whatever medium is sampled it is important that:

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(a) the same hydraulic environment be sampled as consistently as possible.

(b) at all stages of sampling and analysis, samples are of sufficient size to be representative – ideally samples and subsamples should be of sufficient size to contain at least 20 particles of gold if sampling errors are to be better than ± 45% at the 95% confidence level.

(c) For a given concentration of gold, the number of gold particles will increase as particle size decreases. More consistent results are therefore usually obtained with finer grain sizes (e.g. -200 mesh). Use of finer sizes also decreases the effects of hydraulic variability on gold concentrations.

4. In interpreting results it is important to remember that gold concentrations on the stream bed are a function of hydraulic conditions and **can increase**, downstream away from the primary source. Hydraulic ("mini-placer") gold anomalies can be identified by their association with accumulation of other heavy minerals (e.g. magnetite) and by correlation of gold concentrations with stream width, velocity and bed roughness.

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