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Abstract: Returns to both development and exploration were modeled for 77 copper deposits either developed or approved for development between 1992 and 2006. Actual and projected capital and production costs adjusted to 2004 US dollars were used. Metal price estimates were based on average prices over study period and exploration expenditures were from MEG, both adjusted to 2004 US dollars. Economic returns in the form of net present value were determined using an 8% cost of capital. The average discounted exploration expenditure was applied to determine returns to exploration.

Based on a $1.14/lb copper price and an 8 percent cost of capital the average return to development was $183 million NPV per deposit; 20% IRR. The total returns to development were $14 billion.
The distribution of returns to development is highly skewed. 61 of 77 deposits (79%) generated a positive return to development. The top 10% of deposits generated 74% of total net present value.

Greenfields exploration expenditure during the 15 year period in question was $8 billion or $59 million per developed deposit. Taken on an after-tax basis and time-adjusted to beginning of development (average 15 years time-lapse) the discounted discovery cost comes to $132 million per deposit. The average return to exploration is thus $183 minus $132, or $51 million per deposit. 24 of 65 deposits (31%) generated a positive return to exploration. These deposits generated an average return to exploration of $565 million. The top 10% of deposits generated 237% of total returns to exploration.

The most notable characteristic differentiating the deposits that gave positive returns to exploration versus those with negative returns is that they were, on average, over 4X larger. Deposits that gave positive returns averaged 4.1 million tonnes of contained Cu equivalent metal, versus those with negative returns with an average 0.8 million tonnes. While higher grade deposits may give higher IRRs than lower grade deposits, they were smaller on average and thus were not capable of generating the NPV necessary to overcome the discovery cost and give positive returns to exploration. Chilean deposits gave average higher modeled returns to exploration for the period in question, at $292 million, versus those in the rest of the world, at -$57 million. This is reckoned to be due to a combination of their larger size (2.9 million tonnes vs. 1.4 million tonnes of

contained Cu equivalent metal) and lower discounted discovery cost ($65 million vs. $162 million). There is, however, strong evidence that Chile's comparative advantage for returns from greenfields copper exploration is diminishing with time with increasing discovery costs and tonnage-grade-depth characteristics of new discoveries that are becoming less and less favorable.