

69: Gold-binding proteins – 2000s in research in Washington

Gold-binding proteins (GBPs) have recently been recognised as having potential applications in recovering fine gold and in gold exploration. GBPs are proteins that have a high specificity and affinity for gold [188].

A research team at the University of Washington led by Clement Furlong with funding from Placer Dome Inc investigated gold-binding proteins and registered a patent in 2005 (US #6,875,254). The patent is highly innovative but broad-brush in character and the methods it proposes are not yet commercial. However the speed of advance in parallel subjects such as immunology and microbiology may lead to sudden breakthroughs.

The patent stretches the meaning of GBPs to embrace all "gold-specific non-naturally occurring binding ligand to gold" in a protein, polypeptide, peptide, protein fragment, oligonucleotide, carbohydrate, antibody, chelating agent, magnetic agent, hydrophobic agent or any combination of these.

The patent envisages many types of gold recovery mechanisms involving GBP, or rather "binding ligands to gold", such as:

- ✘ GBP-enabled magnetic separation to recovering extremely fine gold particles from magnetite-rich slurry.
- ✘ GBP-assisted floatation using GBPs modified to form a hydrophobic reagent.
- ✘ GBP-assisted microbial recovery of sub-micron gold (<1µ).

Operation

GBP-enabled magnetic separation of extremely fine gold particles from magnetite-rich slurry. A "magnetic mineral binding agent including a gold-specific protein" is added to a sample to form a complex of magnetic mineral and gold. A magnetic field is applied and the complex removed from the liquid. In a lab test, 3µ gold beads were coated with GBP antibodies and bound to magnetic beads to form a complex. Being magnetic, the complex was pulled to the wall of a microcentrifuge in a magnetic field while the other material settled to the bottom of the tube.

In a very different test, gold was bound to natural magnetite by means of a reagent with both gold-and-magnetite-binding-domains to form a complex that could be separated by magnetic methods.

GBP-assisted floatation – a GBP is modified to form a hydrophobic reagent by reacting with valeric anhydride to form a GBP with C<sub>5</sub> hydrophobic tails (C<sub>5</sub>-GBP). A laboratory experiment showed C<sub>5</sub>-GBP bound to extremely fine gold ("micron gold") could reside at the oil-water interface. However in the author's opinion this result should be treated with caution for gold itself is hydrophobic and the merit of adding C<sub>5</sub> hydrophobic tails is not demonstrated.

GBP-assisted microbial extraction and transport is envisaged for recovering sub-micron gold (<1µ). The patent draws attention to strains of *Escherichia coli* cells that express an extra-cellular GBP domain will bind small particles of gold, and then the *Escherichia coli* can be induced to follow a chemical gradient of attractants such as ribose sugar to lead them to a recovery destination.

Adoption by placer gold miners

Gold-binding proteins (GBPs) have yet to be demonstrated as being commercially viable.

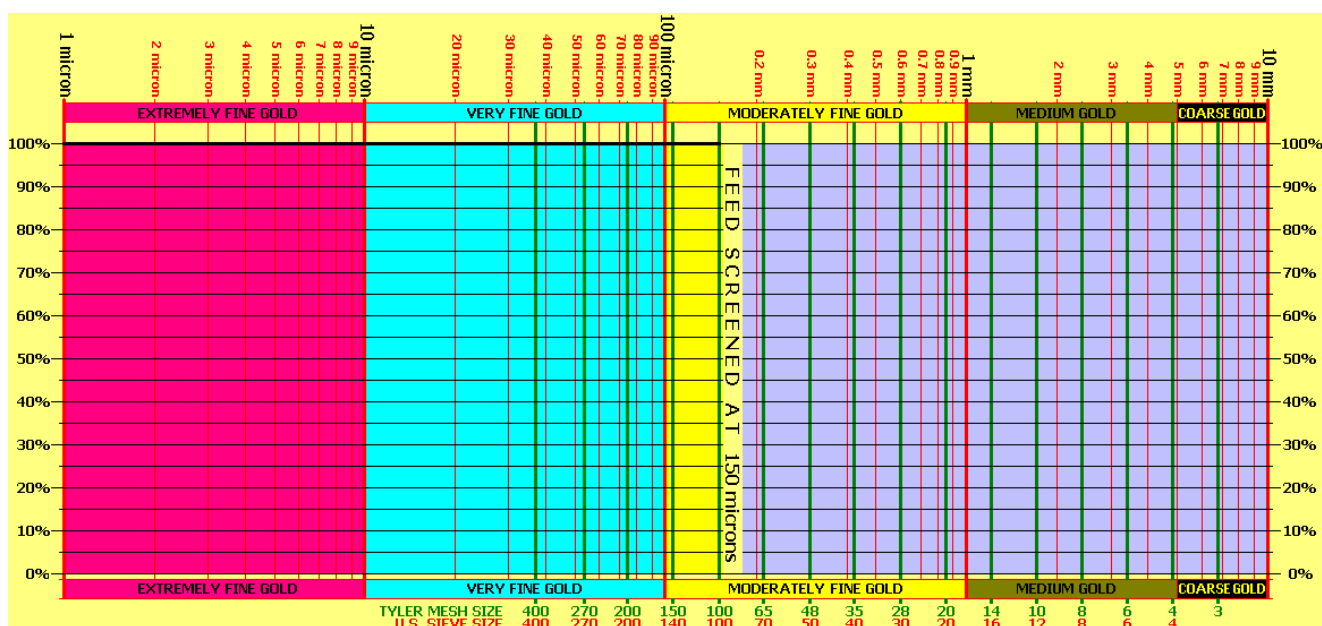


Figure 142. GOLD RECOVERY BY GOLD-BINDING PROTEINS (GBPs)  
 Recovery of gold by gold-binding proteins is not yet commercial but may eventually become so. (compiler: Robin Grayson)