CLAIMS

1. A method of recovering a target metal from a pregnant aqueous solution containing dissolved target metal, the method comprising:

(a) a dissolution step comprising dissolving the target metal from a solid feedstock material with a lixiviant to form a pregnant aqueous solution containing the target metal ions;

(b) a biosorption step comprising contacting a microorganism with the pregnant aqueous solution such that at least a portion of the dissolved target metal biosorb to the microorganism, in which the microorganism becomes metal laden and the pregnant aqueous solution becomes a barren solution;

(c) a separating step comprising substantially separating the metal laden microorganism from the barren solution; and

(d) a recovery step comprising recovery of the target metal from the metal laden microorganism;

in which the concentration factor of the target metal from the pregnant aqueous solution to the microorganism is greater than 5;

in which the target metal is gold and the lixiviant solution is a halogen-based solution.

2. A method according to Claim 1, in which

(a) the pregnant aqueous solution contains more than 10ppm of the target metal; or

(b) the barren aqueous solution contains less than 1ppm of the target metal; or

(c) the concentration factor of the target metal from the pregnant aqueous solution to the microorganism is greater than 10;

(d) any combination of two or more of (a) to (c) above.

3. A method according to any preceding claim, in which in the biosorption step the microorganism is in contact with the pregnant aqueous solution for between 0.5 and 48 hours.

4. A method according to any preceding claim, in which the microorganism:

(a) is a Gram-negative or Gram-positive bacteria; and/or

(b) is selected from an environment where the target metal is found in a physiologically relevant amount.

5. A method according to any preceding claim, in which the separation step includes at least one of:

(a) gravity separation of the metal laden microorganism from the barren aqueous solution and removal of the barren solution,

(b) centrifugation and removal of the barren solution;

(c) filtration of the metal laden microorganism from the barren solution;

(d) any one of (a) to (c) above in which at least 60% of the barren aqueous solution is removed.

6. A method according to any preceding claim, in which the recovery step includes:

(a) contacting the metal laden microorganism with a condition which triggers the microorganism to substantially desorb the target metal; or

(b) burning or chemical dissolution of the metal laden microorganism to desorb the target metal.

7. A method according to Claim 6, in which the condition that triggers desorption of the target metal is:

(a) a solution containing a compound that triggers desorption of the target metal, in which the compound is selected from any one or more of cysteine, or thiosulphate, or thiourea; or

(b) a pH less than 5.

8. A method according to any preceding claim, in which the pregnant solution includes at least one further metal, the microorganism preferentially biosorbs the target metal over the further metal in the biosorption step, and the further metal(s) remains in the barren solution in the separating step.

9. A method according to any preceding claim, in which the pregnant solution includes at least one further metal, and the microorganism preferentially biosorbs the target metal over the further metal in the biosorption step such that the mass ratio of target metal to further

metal in the microorganism increases by a factor of at least 2 when compared to the mass ratio in the pregnant solution.

10. A method according to Claim 8 or 9, in which the further metal is selected from one or more of copper and nickel.

11. A method according to Claim 1, in which the solid feedstock material

(a) comprises a solid material comprising less than 5% of target metal; and/or

(b) is any one or more of an ore, a tailing or e-waste.

12. A method according to Claim 1 or 11, in which:

(a) when present, the solid feedstock material is e-waste, or

(b) when present, the solid feedstock material is gold bearing ore, or

(c) when present, the solid feedstock material is gold bearing sand, or

(d) when present, the solid feedstock material is gold bearing clay, or

(e) any combination of two or more of (a) to (d) above.