Use of Radio-Tracers in Evaluation of Sluice-box Efficiency

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Outline

- Part 1
  - Introduction to Radio-Tracers
  - Summary of Clarkson's Work
  - Some Results Obtained
  - Some Limitations
- Part 2
  - Summary Of Research on Alternative Techniques (to be presented sometime later)

What are Radio-Tracers?

- Selected gold particles (^{197}Au) irradiated, within nuclear reactor, to ^{198}Au
  - One neutron gained
  - Gamma/Beta radiation released
    - Identifiable with scintillometer
    - Short half life
    - Decays back to gold (loss of neutron)

The Au Radioactive Isotopes

Isotope	Mass	Half-life	Mode of decay
^{194}Au	193.96534	1.64 d	EC to ^{194}Pt
^{195}Au	194.965017	186.12 d	EC to ^{195}Pt
^{196}Au	196.966551	6.18 d	EC to ^{196}Pt; β^- to ^{196}Hg
^{198}Au	197.968225	2.694 d	β^- to ^{198}Hg
^{199}Au	198.968748	3.14 d	β^- to ^{199}Hg

After Mark Winter, University of Sheffield, 2000

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Naturally Occurring Gold Isotopes

- There are 35
- Au-171 Au-172 Au-173 Au-174 Au-175 Au-176 Au-177 Au-178 Au-179 Au-180 Au-181 Au-182 Au-183 Au-184 Au-185 Au-186 Au-187 Au-188 Au-189 Au-190 Au-191 Au-192 Au-193 Au-194 Au-195 Au-196 Au-198 Au-199 Au-200 Au-201 Au-202 Au-203 Au-204 Au-205
  - Taken form “Table of the Nuclides”, by Jonghwa Chang, Korean Atomic Energy Research Institute, 2000

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Use of Radiotracers

- Enables backward particle tracking
  - (About 75) irradiated particles are introduced into operating sluicebox; tracer in three size ranges of 600, 300 and 150 microns
    - Each size fraction introduced separately, distribution mapped before introduction of the next size fraction
  - Sluicebox operated for predetermined period
  - Sluicebox stopped, distribution of radioactive particles mapped (location tracers are recovered within box)
  - Gold recovered by standard methods, amalgam digested with HNO_3, tracers separated and counted

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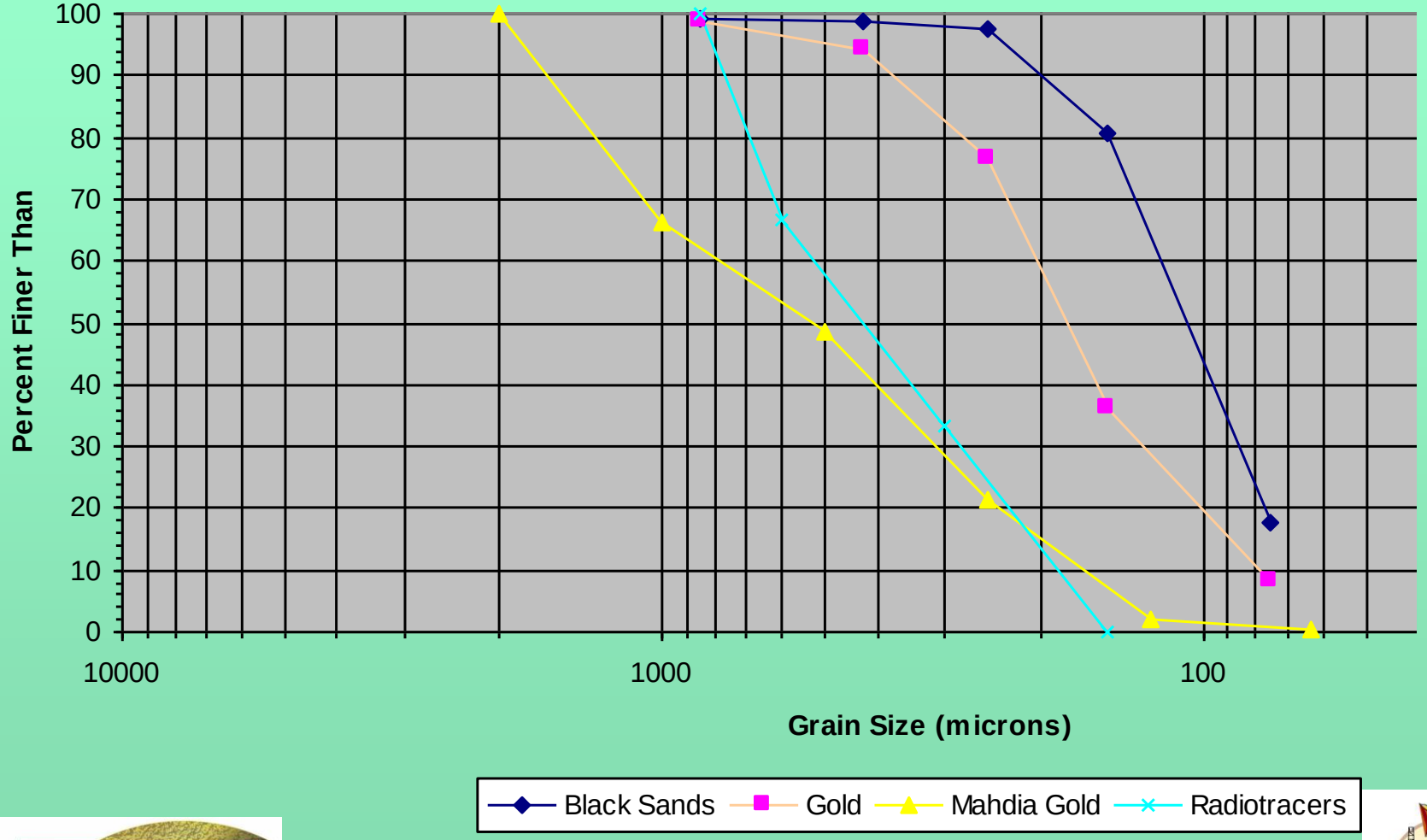
Results

- Confirms that most (90%) of gold is recovered in first 1/3 of sluice length (Fricker, 1984)
- Average increase in radiotracer recovery of 28%
  - Conclusion that (Mahdia) sluiceboxes were too wide for flow rates (flow velocities too low)
  - Achieved by narrowing sluiceboxes (Mahdia), fitting angle iron and expanded metal riffles and Nomad matting

Native Gold Vs. Radiotracer



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Limitations

- Influence of Gold Grain Shape
  - Corey Shape Factor
    - NA gold irradiated and imported; morphology different from local gold, therefore conclusions on recovery of in-situ (native) gold may be misleading
  - Alternative: irradiate gold from location (costly)
- Technique Proprietary
  - Non transferable
  - No long term benefit to Guyanese (will always need Clarkson)

Any Alternatives?

- Equipment With Superior Recovery
  - Knelson Concentrator
    - Recovers 89-95% of gravity recoverable gold
    - Evaluate head grade and tail grade, of representative fraction
    - Assess change in (gravity recoverable gold) recovery
    - More representative than assessment of recovery based on 75 particles of 3 sizes