The significance of the mineralogical and surface characteristics of gold grains in the recovery process

by C. E. FEATHER and G. M. KOEN

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DISCUSSION

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The authors are to be congratulated on drawing attention to the importance of surface characteristics in the treatment of gold grains. I must, however, confess to considerable doubts about the validity of the distribution of gold in "free" and "locked" form set out in Tables I to IV.

The difficulties associated with the determination of mass percentages of free and locked minerals when these occur only as a few parts per million are well known. It would be helpful if the authors could give some details on the following points.

1. How were the mass percentages of the grains determined from the sizes measured in polished section?
2. With a malleable metal, it is possible for flattened particles to settle with their maximum areas parallel to the surface of the mount during preparation. The mass of such particles is small relative to their area. Were any precautions taken to avoid errors due to this cause?
3. The authors mention that their results give only "a rough indication of relative amounts" because of the small number of particles counted. How many particles were actually counted?
4. When heavy and light fractions are prepared, the former are well suited to microscopic examination. The light fraction will probably contain most of the locked particles. How did the authors determine the quantity of locked gold?

I suggest that the results reported would have been much more convincing if some parallel chemical and analytical work had been undertaken. For example, the following scheme might yield useful information:

(i) determine head value a;
(ii) treat sample by prolonged cyanidation, and determine residue b;
(iii) treat residue from (ii) with nitric acid and cyanide again; determine residue c; $(a-b)$ should give a fair idea of the free gold amenable to cyanidation, while $(b-c)$ should indicate the amount of coated gold not soluble in cyanide before acid treatment; c should indicate the locked gold; and this, could possibly be separated by heavy-medium separation into gold locked in thucholite and other locked gold, because of the fairly wide differences in density between thucholite and quartz.

The statement by the authors that the flattened appearance of so many gold grains indicates gross overmilling is surprising. Surely it merely confirms the known fact that gold is soft and malleable?

Is the authors' statement that almost all the gold in the minus 600 μm fraction is free meant to suggest that a grind to minus 600 μm would be optimal? If so, this is not in line with the experience of metallurgists on the Rand. A limiting size of 600 μm would indicate a grind to about 40 per cent minus 75 μm, which would certainly result in high residue losses. This is confirmed by Brittan and Van Vuuren in Fig. 4 of their paper[1].

Finally, I should like to make two minor criticisms of the tabulations. Firstly, the gold and silver assays are presumably in grams per ton; this should be stated. Secondly, the upper limit of the size range, at least of the largest particles, in the second-last column of each tabulation, should be shown. For example, in Table I under "Gold Occurrence" it took me some time to realize that "+150 μm" meant "−600 μm+150 μm" and not "all particles larger than 150 μm".

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REFERENCE

1. BRITTAN, M. I., and VAN VUUREN, E. J. J. Computer analysis, modelling, and optimisation of gold recovery plants of the Anglo-American Group. *J. S. Afr. Inst. Min. Metall.*, vol. 73, no. 7. Feb. 1973. p. 217.

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We wish to congratulate the authors on their very clear presentation of the results of an investigation that must have involved hundreds of tedious man hours at the microscope. As mineralogists, we find it particularly pleasing that the very considerable economic implications of the authors' work are there for all to see.

The authors stress the importance of thucholite as a major contributor to gold losses in residues. It may therefore be of interest to present some of our results obtained on a high-grade washed residue sample from Blyvooruitzicht Gold Mining Co. Ltd.

As shown in the accompanying table, 34,8 per cent of the gold in the residue is contained in the plus 100 mesh fraction, even though this fraction represents only 2,4 per cent by mass of the residue. Many polished sections of the plus 100 mesh fraction were inspected under the microscope, and 203 particles of gold (usually between 3 and 10 μm in diameter) were noted. Of these particles, 141 were found to be occluded in the thucholite, and the remainder in the quartz and other constituents of the residue sample. No "free" gold was observed. On average, the particles of gold in the thucholite are larger than those in

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Size fraction (Tylor mesh)		Mass (%)	Gold content g/t	Distribution of gold (%)
	+100	2,4	7,32	34,8
−100	+200	18,4	0,49	17,8
−200	+325	16,8	0,35	11,6
−325		62,4	0,29	35,8

Gold content of residue (assayed) : 0,58 g/t
„ „ „ „ (calculated): 0,51 g/t

the quartz and other minerals; it can therefore be concluded that much more than 70 per cent by mass of the gold in the plus 100 mesh fraction is occluded in thucholite.

Examination of the various size fractions showed that the thucholite content (around 1 per cent) of the plus 100 mesh fraction is at least ten times higher than that of the finer fractions—further evidence that the thucholite is indeed difficult to mill to fine sizes.

Because of the low gold content of the minus 100 mesh fractions, no reliable figures relating to the distribution of gold particles between the various minerals could be obtained. It is likely, however, that a considerable proportion of the gold in the finer fractions is also contained in the thucholite.

There can therefore be no doubt that research aimed at improving the recovery efficiency of gold from thucholite would be most worth while.

Notices

THE FEDERATION OF SOCIETIES OF PROFESSIONAL ENGINEERS

It is expected that the National Institute of Personnel Research will be conducting a project, at the request of the Federation, to establish the relationship, if any, between the academic and professional achievements of engineers.

The Federation therefore requests those members of the Institute who become involved in this project to co-operate with the researchers.

INFACON 74

The National Institute for Metallurgy, the South African Institute of Mining and Metallurgy, and the Ferro Alloy Producers' Association of South Africa will hold an International Ferro-alloys Congress in Johannesburg from 22nd to 26th April, 1974.

It is the aim of INFACON 74 to stimulate technical interchange on all aspects of ferro-alloy production, and the Congress will include visits to many ferro-alloy plants, where delegates will have an opportunity of seeing the latest developments in production in this country.

Technical Sessions

The technical sessions will cover a wide range of topics in ferro-alloy technology and production, and will include the following.

1. Burden preparation, blending, pelletization, handling, reducing agents.
2. Electric smelting furnaces—design, operation, management, smelting optimization, shop practice, refractories.
3. Mineralogy, reduction behaviour, smelting reactions, slags.
4. Automation, pollution control.
5. Applications, trends in consumption, trends in composition specifications.

There will be no parallel sessions, and provision will be made for panel discussions and informal meetings.

Guest Speakers

Dr J. Nasu—Awamura Metal Industry Co., Japan
Mr W. H. Magruder—Union Carbide Corp., U.S.A.
Mr R. Björklund—A/B Ferrolegeringar, Sweden
Mr H. Franke—Gesellschaft für Elektrometallurgie, West Germany.

Registration

Registration closes on 28th Feb., 1974. Forms are obtainable from The Secretary, Organizing Committee, INFACON 74, Private Bag 7, Auckland Park, Transvaal.

INTERNATIONAL PLATINUM SYMPOSIUM OF THE SOCIETY OF ECONOMIC GEOLOGISTS

The above symposium is to be held at the U.S. Geological Survey, Denver Federal Center, Denver, Colorado, from 13th to 17th October, 1975. Papers up to 40 double-spaced typewritten pages in length, including tables and figures, are invited, and those accepted will be published in the journal *Economic Geology*. Titles of papers should be submitted now. The subject matter of the symposium includes the occurrence of individual deposits, the regional and tectonic setting and worldwide distribution of rocks containing notable concentrations of platinum-group elements, the geochemistry of platinum-group elements, exploration techniques, resources, and reserves.

Enquiries should be directed to George A. Desborough, Convenor, U.S. Geological Survey, Bldg. 25, Denver Federal Center, Denver, Colorado 80225, U.S.A.

THIRD MEETING—CANADIAN HYDROMETALLURGY GROUP

The Hydrometallurgy Group of the Metallurgical Society, Canadian Institute of Mining and Metallurgy, will hold its Third Annual Meeting, October 1 and 2, 1973, at Edmonton Alberta.

Emphasis will be on nickel metallurgy and a field trip to the Sherritt-Gordon plants at Fort Saskatchewan is scheduled for October 2 as part of the Meeting programme.

For more information, contact Mr G. van Weert, Secretary of the Hydrometallurgy Group, Falconbridge Nickel Mines Limited, P.O. Box 900, Thornhill, Ontario L3T 4A8, or Mr H. Veltman, Sessions Chairman, Sherritt-Gordon Mines, Fort Saskatchewan, Alberta.