

Geochemical analysis of iron oxide/hydroxide coated and uncoated non-magnetic component of the bulk sample: Possible utility of the coated component in a stream sediment survey for gold

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The possible relationship between the secondary Fe-oxides/hydroxides and particulate gold in the surficial environment is presented in this communication. Coated non-magnetic component separated from bulk, using isodynamic separator, shows much higher values for gold compared to the same of the uncoated. The increase in concentration is related to the possible affinity between the secondary oxides/hydroxides and particulate gold and the abundance of the two in the area. Possible affinity between these oxides/hydroxides and colloidal, fine/dust particles, etc. of gold may make the total coated component (coated magnetic + non-magnetic) useful to provide an additional data on adsorbed gold apart from particulate. Positive relationship between iron oxides/hydroxides and gold values suggests the utility of the total coated component in general and coated non-magnetic component in particular in stream sediment survey for gold.

THERE are many reports in the literature about the presence of Fe-oxide/hydroxide coating in secondary environment, particularly in the zone of weathering and its relation to gold¹⁻⁵. It is also observed that the lateritic gold enrichment can be associated with the formation of colloidal gold and its interaction with the iron-oxide-rich medium. Adsorption of colloidal gold on synthetic goethite and hematite was measured experimentally at 25°C and it was observed that the affinity rate depends more on the composition of the medium. Inert electrolytes, if present, are expected to enhance the effect⁶. This information provides the impetus to study the relationship between the iron oxide/hydroxide coating and the particulate gold.

The shortcomings in the sample-processing scheme to separate iron oxide/hydroxide-coated particulate gold from heavy mineral concentrate⁷ and its implications on gold exploration are discussed earlier by the author⁸. The utility of another component, i.e. the total iron oxide/hydroxide-coated component in general and coated non-magnetic component in particular of the bulk sample in gold exploration is reported here.

Stream sediment samples collected earlier during an orientation survey for gold from an area known for Au and Cu mineralization near Bhiwapur, Nagpur district, Maharashtra⁷ were used in this study. Details about

geology of the area, sampling, etc. are provided elsewhere⁷. About 1 kg of partly iron oxide/hydroxide-coated -30+50 mesh size (-0.59+0.297 mm) bulk sample was run in a isodynamic separator at 1.2 Å (25° forward/15° side slope) to separate magnetic and non-magnetic components⁷. Magnetic component in this case contains iron oxide/hydroxide-coated magnetic and non-magnetic minerals plus uncoated magnetic minerals. So, both coated magnetic and non-magnetic minerals form the total coated component present in the sample. Since we mainly deal here with the coated non-magnetic component, the total coated component was treated with dilute HCl (to remove coating) before further separating the earlier coated non-magnetic minerals⁷. The non-magnetic component thus separated at two stages firstly, from bulk and secondly from the total coated component, was analysed separately for gold.

Fifty grams of the first and 20 g of the second stage non-magnetic component were separately ground approximately close to -120 mesh size. It was then transferred into a beaker and treated with 50-60 ml acid mixture (hydrobromic acid + few drops of bromine solution)^{7,9}. The sample was then washed and transferred into a 100 ml volumetric flask containing 10 ml iso-butyl methyl ketone (MIBK). After shaking the solution for few minutes, the organic layer was analysed for gold using AAS (Perkin-Elmer, 2380) at Department of Geology, University of Delhi. The data thus generated are presented in Table 1.

The secondary oxides/hydroxides of Fe, Mn, etc. known to be active in the surficial environment, not only coat the grains⁷ of different sizes but also facilitate accumulation of ionic, colloidal⁶ dust or fine particles^{1,2}, etc. of different minerals or elements through absorption and adsorption processes. In the present case, about 4-22%

Table 1. Gold data (in ppm) on iron oxide/hydroxide coated and uncoated non-magnetic component and approximate percentage of coated non-magnetic and total coated component in the bulk sample

Sample number	A	B	C	D
1	0.1	0.6	10	20
2	0.1	0.4	11	22
3	0.1	0.5	7	14
4	<0.1	0.2	6	12
5	0.1	0.3	7	14
6	0.1	0.2	6	12
7	<0.1	0.3	7	14
8	<0.1	0.2	4	8
9	<0.1	0.1	6	12
10	<0.1	0.1	3	6
11	<0.1	<0.1	3	6
12	0.1	<0.1	2	4
13	<0.1	0.1	3	6

A, Uncoated non-magnetic of the bulk sample.

B, Coated non-magnetic of the bulk sample.

C, Approximate percentage of coated non-magnetic component.

D, Approximate percentage of total coated component (i.e. coated magnetic + non-magnetic).

(assuming to be twice the amount of coated non-magnetic grains/minerals (Table 1)) of the grains (-30 + 50 mesh size) are estimated to be coated by these oxides. Thus it is important to understand the pattern of coating either selective or random. Since these oxides are also known to coat the gold grains⁷, it is also important to understand the relationship between them in terms of geochemical survey.

Data (Table 1) generated on coated non-magnetic component (<0.01–0.6 ppm) compared to that of the uncoated (<0.01–0.10 ppm) component show much higher values for gold. These enhanced values not only suggest the possible affinity between these oxides/hydroxides and gold but also the relationship of particulate gold with the intensity of these coatings. Since about 2–11% of the bulk sample comprises iron oxide/hydroxide-coated non-magnetic grains, the values recorded for gold in the non-magnetic component either low (of first stage) or high (of second stage) are expected to be influenced by these percentages. It is well reflected in the gold values of the coated non-magnetic component where sample no. 1, coating being approximately 10%, shows 0.6 ppm and sample no. 9, with 6% shows only 0.1 ppm. This relationship, though not exactly linear is also seen in Figure 1.

The data not only confirm the earlier report on gold nuggets recovered from such similar component⁷ but also indicate the possible utility of such coated non-magnetic component in a stream sediment survey for gold.

The above observation together with the experimental data on colloidal gold⁶ probably indicate the possible affinity of these oxides not only to particulate but also to colloidal, dust/fine particles, etc. of gold in the secondary environment. Though the proportion of gold (different forms) that is going to be enriched in the presence of these oxides is not clear, their role in influencing particulate gold values (Table 1) and colloidal gold⁶ is better understood. Thus, coatings become useful to provide information on both particulate and adsorbed gold. In the case of particulate gold, only the coated non-magnetic component, i.e. 2–11% (present case) is utilized. Whereas in the case of adsorbed gold the total coated component about 4–22% (i.e. coated magnetic + non-magnetic) is utilized.

Hence, the presence of iron oxide coating on the one hand affects the separation of particulate gold in the case of HMC⁷ and on the other may provide useful information on colloidal, dust/fine particles, etc. of gold, apart from particulate (Table 1) in the case of total coated component of the bulk sample.

Further, it is suggested that there is a need for a suitable sample-processing scheme, where the secondary iron oxides/hydroxides are conspicuous, to recover both

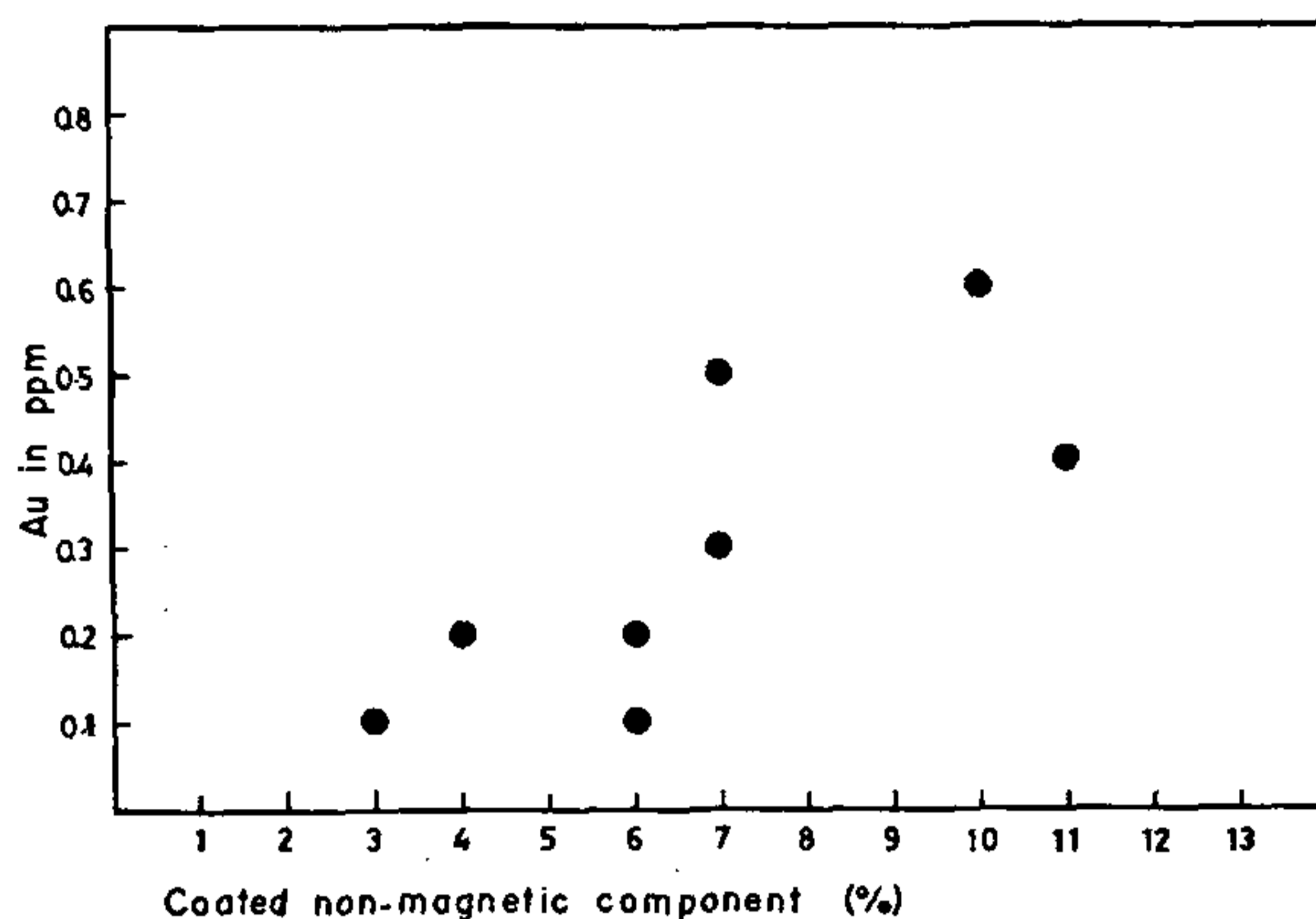


Figure 1. Positive relationship between the percentage of coated non-magnetic component vs gold concentration.

absorbed and adsorbed gold apart from particulate from bulk sample.

To conclude, iron oxide/hydroxide-coated non-magnetic component yields higher values for gold (particulate) compared to the uncoated component. Possible affinity among Fe-oxide/hydroxide and colloidal⁶, dust/fine particles, etc. of gold makes the total coated component important for adsorbed apart from particulate gold. Since a positive relationship is observed between the intensity of coating and gold values (of particulate), a similar trend may be expected also in the case of adsorbed gold. Coated component like heavy mineral concentrate seem to have some application in geochemical survey for gold, particularly in areas where iron oxide coating is quite conspicuous.

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