2- The ore is coarse grain in nature and due to some tectonic process it is not compact in nature, so it may be amenable to coarse particle leaching process.
3- Sieve analysis, chemical analysis of different sieve fractions and sink and float tests shows that most of the gold particles are distributed in sizes between 500 to 2000 microns so, it seems some of the methods like coarse particle leaching may be the suitable extraction technique.

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Sink and float tests

In order to determine the degree of liberation of gold particles from other constituent minerals, heavy liquid tests have been carried out on -2000 microns sample using Tribromoethane as a heavy liquid and acetone as a solvent (both of which are supplied by Merck Company). The results obtained are given in Table 3.

Table (3) Sink and float tests on different Size fractions.

Separation densities (gr/cm^3)	Wt (%)	Gold (%)	Distribution (%)	Cum. Distribution (%)
-2.6	2.5	0.5×10^{-4}	0.34	0.34
2.6-2.7	25	0.5×10^{-4}	3.48	3.82
2.7-2.8	39.5	0.8×10^{-4}	8.80	12.62
2.8-2.9	7.5	3×10^{-4}	6.27	18.89
2.9-3	10	8×10^{-4}	22.29	41.18
3-3.1	7.5	10×10^{-4}	20.90	62.08
+3.1	8	17×10^{-4}	37.92	100
Total	100	3.588×10^{-4}	100	

Results and Discussion

Table 1 shows a high percentage of SiO_2 and petrographic investigation (Fig.1) shows that quartz is the main gangue mineral, in which the gold particles may be present in the form of solid solution. However, some gold particles may also exist as inclusions in hematite (Fig.4) which is the product of pyrite oxidation (Fig.2 and 3).

This investigation indicates that the ore is not refractory in nature but may be in the free state and (Fig. 5, 6) the situation of tectonic criteria, converted the zones into crushed product, thus made the ore amenable to leaching at coarser size fractions.

This is mainly because the concept of liberation in leaching and mineral dressing is somewhat different. During typical mineral beneficiation, ore must be ground into small particles compared to valuable mineral grain size, to obtain free particles, and then separated into concentrate and tailing. The same idea can also be applied to leaching, in which valuable grains are liberated from the state of being included within a matrix to that of being exposed at the particles surface but in which it is unnecessary to liberate them as free particles by further size reduction [7].

Figure 7 and Table 3 shows that most of the gold particle are distributed in the size ranges of 500 to 2000 microns and it is supplemented with the petrographic investigation and further confirms the coarse particle leaching may be the suitable alternative technique for the gold extraction .

Conclusion

The authors have drawn the following conclusions:

The gold deposits of Neishaboor area of Iran was subjected to characterization studies and found that:

1- The ore may be oxidized and gold with an average grade of 4 ppm exist partly in quartz veins as well as in the form of free particles in hematite which is the product of pyrite oxidation. This is very important from the extraction point of view. The SEM studies also confirms the petrographic findings.

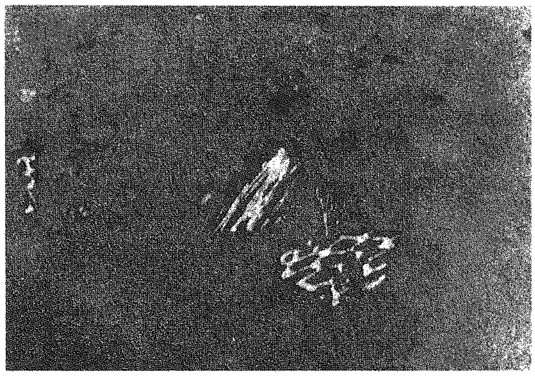

Figure (2) Microphotograph of Boxwork structure of pyrite subjected to oxidation process (X 20 × 12.5 ppl).

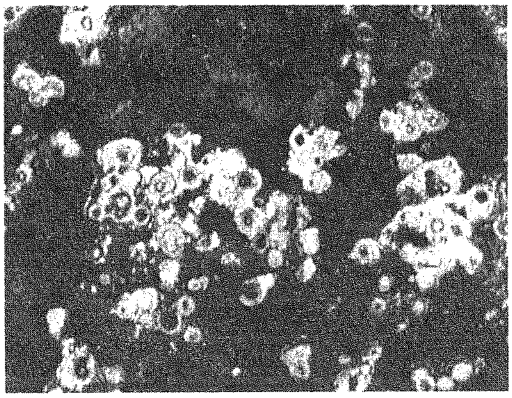

Figure (3) Microphotograph of substitution of pyrite by iron oxides (X 20 × 12.5 ppl).

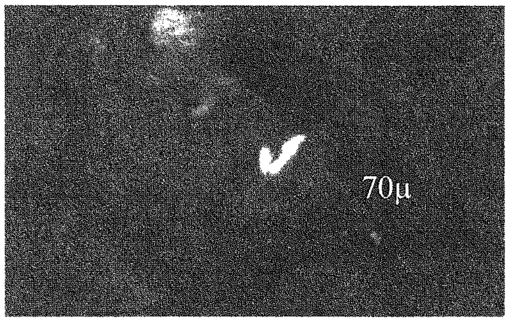

Figure (4) Microphotograph of gold particle ($110 \times 70\ \mu$) in iron oxides (brown colure) (X 20 × 12.5 ppl).

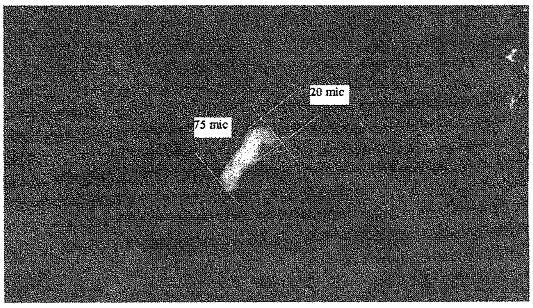

Figure (5) SEM (microphotograph of gold particle) X 20 * 12.5 ppl.

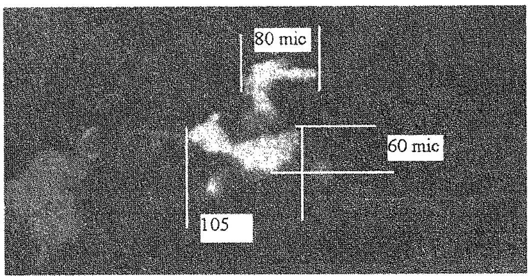

Figure (6) SEM (microphotograph of gold particles) X 20 * 12.5 ppl.

Particle size and chemical analysis of sieve fractions

The representative samples have been subjected to wet particle size and chemical analysis. The results obtained are illustrated graphically in Fig .7

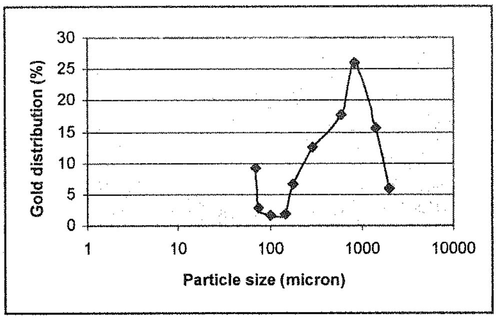

Figure (7) Distribution of gold particles in different sieve fractions.

fraction. The sampling techniques like Jones riffles and coning and quartering methods have been adopted and the representative samples were prepared for further studies.

Chemical analysis

The sample for head assay was obtained by coning and quartering and rotary sampler. The results of chemical analysis are tabulated in Table 1.

Table (1) Chemical analysis of gold sample.

Constituents	Weight %
SiO_2	84.5
Al_2O_3	5.2
Fe_2O_3	5.0
CaO	0.98
MgO	0.16
Na_2O	0.09
K_2O	0.17
Au	4 ppm
Others	3.36
Total	100

X - Ray diffraction studies

In order to identify the type of the mineral constituents of the sample the powder X-Ray diffractogramms have been obtained for the sample ground to -200 meshes employing a Philips powder diffraction unit. From the XRD studies and with help of table 1 it is possible to find out that quartz is the main mineral (83 %). Other minerals like hematite, pyrite, calcite and feldspar are present in order of abundances.

Petrographic studies

In characterization studies the petrographic investigation plays an important role. Apart from the volumetric proportion of the ore and gangue minerals, and the grade, other characteristics such as grain size, texture and intergrown are equally important for the beneficiation studies. The thin and polished sections of prepared gold samples were subjected to petrographic studies. The modal proportion and grain size of the gold and other constituent minerals (average of 30 sections) are given in Table 2. Microphotographs are also illustrated in Figs 1 to 4.The SEM studies which confirm the petrographic studies are also shown in Figs 5 and 6.

Table (2) The modal analysis and grain size of the constituent minerals (or metals).

Sl No	Mineral	Modal percentage	Grain size (micron)
1	Quartz	84	5-500
2	Hematite	4	30-80
3	Calcite	3	70-90
4	feldspar	3	5-400

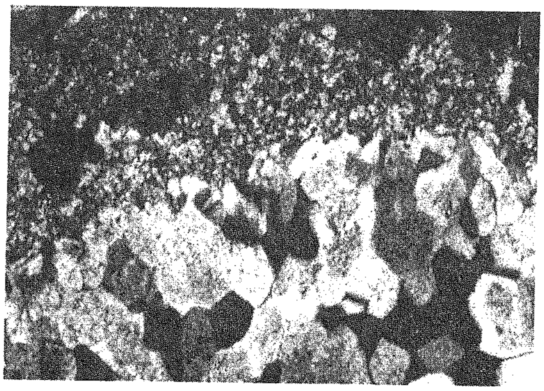

Figure (1) Microphotograph of large particles of quartz with small crystals of quartz and feldspar (X 20 × 12.5 ppl).

The Characterization Studies of Gold Deposites From Neishaboor Area of Iran From Beneficiation Point of Veiw

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Abstract

Large reserves of gold deposits have been reported from different parts of Iran, specially at the Neishaboor area which is very high grade approximately 4 ppm in nature, but the characterization studies must be carry out before beneficiation. For mineralogical composition, the nature of the minerals, type of Gold, chemical characters and the suitable mesh of grind play a vital role in finding out suitable beneficiation techniques. The representative samples were subjected to detailed mineralogical, sieve analysis, chemical analysis and liberation studies. The results show that, the ore is oxidized and gold may be present partly in the form of solution in quartz veins as well as in the form of free particles, in iron hydroxides specially, hematite which is the product of pyrite oxidation. The SEM studies also confirms the mineralogical studies. Quartz, hematite, calcite and feldspar are the main minerals present in the order of abundances. Sieve analysis and distribution of gold particles in different sieve fractions and also sink and float tests show that most of the gold particles are distributed bellow 2000 microns specially between 1500-2000 microns.

Keywords

Gold, Mineralogy, Petrographic, characterization

Introduction

The characteristics of an ore deposit and its mineral assemblages determine the mining methods, extraction process requirements and, in particular, the performance of all beneficiation and chemical processes involved in precious metals extraction. Consequently, a good understanding of the mineralogy of the matrix material (sample) is required to design or operate an extraction or beneficiation process with optimum efficiency [1-4].

Gold is usually associated with complex sulfide ores, and conventional straight cyanidation is used to extract gold if it occurs in the boundary of the mineral particle. But when gold is inclusive in the sulfide mineral, pretreatment like roasting, oxidation, bioleaching and many others is required to decompose the sulfides and expose the gold particle surface [5].

The gold deposits of Neishaboor area, which is situated in Northern east of the country, have not been subjected to systematic characterization studies so far. However the detailed beneficiation studies have been carried out by the authors recently [6]. This paper deals with a characterization studies which are discussed in an appropriate part of the paper.

Experimental Methods

Sample preparation

A part of bulk sample received, was reduced in size carefully by a jaw and roll crusher in closed circuit with a single deck screen to give a crushed product of -6 meshes (ASTM)