Chapter 1. Introduction

The Rosh Pinah zinc-lead sulphide deposit occurs in the Southwestern part of Namibia, close to the Orange River. Underground operations and housing projects started in 1967 and the mine came into production in 1969 (Van Vuuren, 1982). The Rosh Pinah Mine treats a composite of copper-lead-zinc sulphide ores from various sites. Pyrite is the main sulphide gangue mineral in the Rosh Pinah composite sample. Traces of chalcopyrite, gold and silver are found in the ore sample (Figure 1.1).

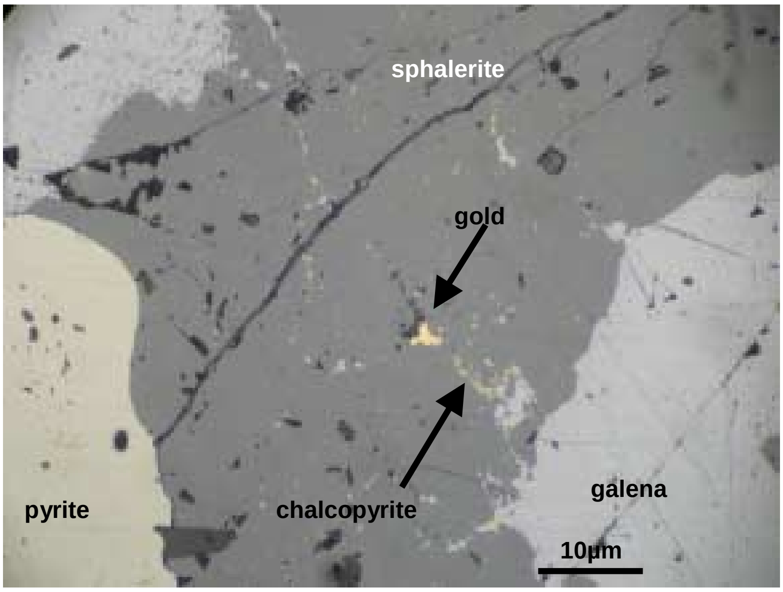

Figure 1.1. Photomicrograph showing sulphide minerals and gold in the Rosh Pinah ore sample.

The Rosh Pinah composite sample is processed by selective flotation, in which galena is floated first with sodium propyl xanthate (SNPX) as collector, while sphalerite and pyrite are depressed with cyanide. The sphalerite is floated further with xanthate in the zinc flotation circuit after activation with copper sulphate. Selectivity against sphalerite poses a difficult challenge in the lead flotation circuit at the Rosh Pinah Mine, where cyanide dosages as high as 150-180 g/t are being used to suppress the flotation of sphalerite and pyrite at the concentrator.

Although cyanide is an effective depressant in selective flotation of sulphide minerals, considerable amounts of zinc are still recovered together with lead, reflecting poor selectivity during the flotation of galena at Rosh Pinah. High dosages of cyanide are required to overcome this situation. Apart from the significant contribution to the loss of precious metals such as silver and gold by forming soluble metal complexes, the excessive use of cyanide is a cause for concern on environmental grounds. Furthermore, this necessitates the use of more copper sulphate to activate sphalerite for its subsequent flotation in the zinc circuit.

Analysis of the process water used at the Rosh Pinah Mine has shown that considerable amounts of copper, lead, iron, and calcium are regularly present in the recycled process water (Table 1.1). Thus, activation of pyrite and sphalerite can occur during the flotation of galena due to the presence of the dissolved copper and lead ions (Fuerstenau and Metzger, 1960; Trahar et al., 1997; and El-Shall et al., 2000). Houot and Raveneau (1992) have also shown that sphalerite can be activated by lead ions derived from galena and oxidised lead minerals.

Table 1.1. Survey of the process water used at the Rosh Pinah Mine (After Du Preez, 2000). Assays in mg/L

SLIMES (%)	28
pH	8.4
Eh (mV)	-90
Temperature (°C)	38-60
Oxygen in solution	0.1-0.3
Lead in solution	10-30
Copper in solution	10-80
Calcium in solution	600
Total dissolved solids	1000-3000

Rao and Finch (1989) have shown that an increase in the use of recycled water in flotation circuits often has a negative effect on flotation selectivity. This can be due to the combination of factors such as residual xanthate and dixanthogen, which adsorb unselectively on most sulphide minerals, metallic ions such as $Cu^{2+}$and Pb^{2+} that cause inadvertent activation, and alkaline earth metals which may activate the non-sulphide gangue.

It is usually difficult to quantify the exact amounts of dissolved heavy metal such as copper and lead present in the water system at alkaline pH value because these metals form hydroxides which do precipitate. Thus, it is also difficult to assess the activation of sphalerite from the complex Rosh Pinah ore by only assaying the dissolved lead and copper present in the process water. Since the plant uses recycled water from different flotation streams, it is believed that the quality of water might have an influence on the flotation response of the ore.

In flotation practice, the optimization of reagent at various stages can be very difficult to carry out when the processes involved are not well understood. Moreover, the Rosh Pinah Mine is located in an arid region necessitating the optimal use of the available water resources. Thus, the objectives of this study were to:

1. understand the mechanisms involved during the selective flotation of galena and sphalerite at Rosh Pinah Mine;
2. optimize the reagent suite for galena recovery based on the fundamentals which describe the activation of sphalerite by heavy metal ions;
3. study the influence of the recycled process water on the flotation selectivity of galena and sphalerite in the lead flotation circuit;
4. reduce the cyanide consumption for the depression of sphalerite during the flotation of galena by using cyanide in conjunction with another depressant such as zinc sulphate;
5. Study the deportment of sphalerite in the lead concentrate and the mineralogical texture of the flotation products.

The scope of this study was limited to optimizing the flotation selectivity between sphalerite and galena in the lead flotation circuit, because it is necessary to understand the phenomena that contribute to the presence of zinc in the galena concentrate at Rosh Pinah Mine. There was no attempt to produce generic data on the flotation of single sulphide minerals. However, flotation data from the literature were used during the interpretation of results.