

enrichment factor of carbon is 896 which are attracting. Since EDX technique showed minor concentrations of Rb, Cu and Zn. their recoveries as by product may also be considered.

G. Microbiological Characterization of Chimiari Black Shale

The presence of some rod-shaped, motile and aerobic bacteria in the black shale ore sample was observed under the phase-contrast microscope at X100 magnification (Figure-3.3). Standard microbiological techniques were employed for the isolation and characterization of indigenous bacteria present in the black shale ore sample.

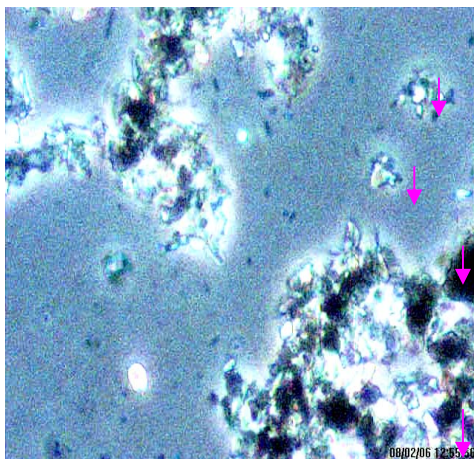


Figure 3.3 Phase contrast microscope (X100 magnifications) showing the presence of rod-shaped bacteria (indicated by arrow) in black shale ore-water slurry.

Indigenous microflora of acidophilic iron- and sulfur-oxidizing mesophile (grow at 10-45°C) and moderate thermophile (45 - 60°C) were isolated and characterized as *Acidithiobacillus ferrooxidans* (BSTF-1) similar as [13] and *Acidithiobacillus caldus* (BSMT-1), respectively.

4. Conclusions

The sample from Chimiari black shale deposit was examined & studied for the physical, mineralogical, chemical, radiological and biological characterization. The followings are the conclusions drawn from the studies mentioned above.

The flakes are easily visible and pyrite can also be seen with naked eye. The streak is black. According to the Moh's scale the hardness is between 4 & 5. The specific gravity is 2.85 and moisture contents are 0.9%. The porosity is found 45%. The sample shows low level γ -radio activity. The black shale, under study, is a complex in nature.

XRD studies show that quartz, K-feldspar, calcite, illiminite and pyrite are present in the black shale of Chimiari. Table-5 shows that the elements of C, Ti, Mn, U and V have been accumulated as these have attained an enrichment level of 896, 1.43, 1.41, 16.67 and 21.58 respectively. Therefore the Chimiari black shale may be characterized as polymetallic / polyelement black shale because of the enrichment of C, Ti, Mn, U and V. TOC is the 2nd highest element in

concentration and its concentration is 17.92%. It is therefore concluded that Chimiari black shale is heavily enriched with TOC.

Rod shaped bacteria are found under the phase-contrast microscope at X100 magnification. This means that the bio-froth flotation is possible.

5. Recommendations

In the light of the conclusions, it is recommended to carry out the following studies on Chimiari black shale deposit.

- Detail analysis of Chimiari black shale for trace element such as Ag, Au, Li, Se, etc. should be carried out. So that these may also contribute towards the economic recovery of valuable metals.
- Since the black shale is a complex in nature for recovering valuable minerals, so the detailed study of surface properties of minerals is required to sufficient utilization.
- SiO₂ being the main impurity, could not be separated from valuable metals. Therefore it is strongly recommended that flotation experiments with "cation" class of reagents may carried out as these reagents are characterized by their marked selectivity towards silicates.
- Fine grinding may be successful to segregate the valuable mineral contents and organic carbon content but with pretreatment procedures.
- Detailed study for the respective minerals should be carried to get the mesh of liberation for each of the mineral present.
- Direct leaching with H₂SO₄, HF and H₂O₂ as oxidizing agent may be utilized for vanadium and Titanium extraction.
- Environmental studies regarding the concentration of some toxic elements are carried out for better understanding of the mineral deposit.

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Author Profile

Abdul Aziz Received MSc Chemistry and MS degrees from Islamia University Bahawalpur and Pakistan Institute of Engineering and Applied Sciences Islamabd- Pakistan in 2004 and 2007 respectively. From 2007 to till date he is doing work in collaboration with Pakistan Institute of Nuclear Science and Technology, Islamabad Pakistan

Muhammad Sajjad Received M.Sc.Chemistry and M.Phil Chemistry from Government college University Lahore and University of the punjab lahore in 1998 and 2005. Currently Ph.D scholar at University of Science and Technology, Korea

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