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# Standard Procedure SP 0006-3:2005

## Chemical tests for identifying cations and anions in minerals – Part 3: Tests for cations

### 1 Scope

This Standard Procedure uses simple chemical tests to detect and distinguish between calcium, copper, iron(III) and lead ions. It may be used for minerals and ores containing one or more of these ions, and/or sodium and potassium ions. Other cations may interfere, giving misleading results.

### 2 Definitions

*mineral*

a naturally occurring solid, consisting mainly of one chemical with a fixed composition

*ore*

a mineral from which a metal is extracted on a commercial basis

*cation*

a metal atom carrying a positive charge

*precipitate*

a solid product formed when two solutions are mixed, making the mixture cloudy or opaque

*gelatinous precipitate*

one with a jelly-like appearance

### 3 Principle

The mineral sample solution is reacted with chemical reagents that give characteristic reactions with each of the four cations. The results show whether or not the mineral contains a particular cation.

### 4 Apparatus and Reagents

- rack of 2 test tubes
- 4 droppers (unless reagent bottles have built-in droppers)
- eye protection
- sodium hydroxide solution (approx  $1 \text{ mol dm}^{-3}$ ) **CAUTION:** corrosive
- ammonia solution (approx  $1 \text{ mol dm}^{-3}$ )
- hydrochloric acid (approx  $1 \text{ mol dm}^{-3}$ )
- potassium thiocyanate solution (approx  $0.1 \text{ mol dm}^{-3}$ )

### 5 Test Specimens

Use the specimen solution prepared in Part 1.

### 6 Procedure

- Note the colour of the specimen solution, and of the powder recorded in Part 2. Blue or green suggests copper ions. Yellow or brown suggests iron(III) ions. Colourless or white indicates the **absence** of copper, iron and other transition metals.
- To about  $1 \text{ cm}^3$  of the specimen solution in a test tube add drops of sodium hydroxide solution until a precipitate forms, or until the volume has doubled but no precipitate forms. Perform further tests according to the colour below.
  - If **no** precipitate forms, the sample does not contain calcium, copper, iron or lead. It may contain sodium or potassium. See Part 2.
  - A **blue** gelatinous precipitate indicates copper ions. Add  $2 \text{ cm}^3$  ammonia solution and mix well. The precipitate redissolving to give a deep blue solution confirms copper ions  $\text{Cu}^{2+}$ , in the sample.
  - A **brown** gelatinous precipitate indicates iron(III) ions. Add dilute hydrochloric acid dropwise until the precipitate redissolves. Add 2 drops of potassium thiocyanate solution. A deep red colour confirms that the sample contains iron(III) ions  $\text{Fe}^{3+}$ .
  - A **white** precipitate indicates lead ions, or calcium ions. Add a further  $1 \text{ cm}^3$  of sodium hydroxide solution and mix well. The precipitate redissolving confirms lead ions  $\text{Pb}^{2+}$  in the sample. The white precipitate remaining or increasing confirms the sample contains calcium ions  $\text{Ca}^{2+}$ .
- To confirm the distinction between lead and calcium, test another portion of the original sample solution.

Add  $1 \text{ cm}^3$  of ammonia solution.

  - A white precipitate confirms lead ions.
  - No precipitate confirms calcium ions.

### 7 Expression of Results

Present your findings in a way that shows clearly what tests you performed, what you observed, and what these observations told you about the sample.

### 8 Test Report

Your test report should include:

- (a) reference to this Standard Procedure;
- (b) the identity of the sample (for example, Sample A);
- (c) which cation you found in the sample.