

Moire patterns, colour discs, magnets, and other simple scientific devices to amuse and occupy the child.

The teaching section is followed by the Royal Ontario Museum's Gem Collection where the visitor can learn about the properties of gems.

We hope this introduction will better prepare the layman to appreciate the carefully selected specimens in the Systematic Collection which follows, and that he will come away entertained and informed rather than overwhelmed and bewildered.

THE SURFACE EXPRESSION OF KIMBERLITE PIPES

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The recent discovery in Northern Ontario of rocks resembling kimberlite has stimulated interest in the possibility of finding primary diamond deposits in the Canadian Shield. This paper describes the surface expression of kimberlite pipes, particularly citing the features which may assist in the discovery of pipes in overburden-covered areas.

Kimberlite occurs as clusters or lines of dykes and pipes in cratonic areas. The pipes range from a few tens of feet to nearly a mile in diameter and exhibit a wide variety of shapes. Most pipes are less than 500 feet in maximum diameter.

Even in non-glaciated regions, topography, soil, and vegetation rarely indicate the presence of underlying kimberlite. Photogeology and geophysical techniques are useful mainly in outlining known pipes or in finding adjacent pipes once a discovery has been made.

The most diagnostic surface evidence of kimberlite is the presence in residual soil or alluvium, of certain heavy resistant accessory minerals. Magnesian ilmenite, chromian pyrope-almandine garnet, and chrome-diopside are the most useful indicators. The detection of these minerals, and the determination of their distribution, offer the best practical means of discovering unexposed kimberlite pipes. Some applications of the heavy mineral technique in Africa are described.

CRYSTALLOGRAPHIC POLARITY IN CHALCOPYRITE

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Chalcopyrite is a non-centrosymmetric mineral belonging to the space group $I\bar{4}2d$. Natural crystals of chalcopyrite are commonly tetrahedral in appearance, displaying the sphenoidal faces of the form $\{112\}$. The sphenoidal form in itself lacks a center of symmetry and thus the morphology of most chalcopyrite crystals immediately reveals the polar character of the mineral. In cases where both sphenoidal forms are present, one usually dominates while the other is considerably inferior in size. The large face, designated as $\{112\}$, is always dull in lustre or oxidized and striated parallel to $[1\bar{1}0]$; the faces of the $\{\bar{1}\bar{1}2\}$ are small, brilliant, not striated, and not oxidized.

The crystallographic polarity of chalcopyrite has been established by x -ray diffraction intensity measurements considering anomalous dispersion effects. Consistent with theoretical calculations, the geometric structure factor for x -ray scattering was found different in opposite directions along the $[112]$ polar axis. Consequently, the two types of surfaces perpendicular to the polar axis were identified. The etching behaviour of these surfaces was correlated with the x -ray results so that simple etching tests were developed for the differentiation of $\{112\}$ from $\{\bar{1}\bar{1}2\}$.

Euhedral chalcopyrite crystals displaying the sphenoidal form were studied from 15 different geologic environments. In every case the dominant sphenoidal faces were found to be Cu-Fe surfaces. This demonstrates that the anion direction $[11\bar{2}]$ is the fast growing direction as opposed to the cation direction.

The polarity of chalcopyrite was further related to the polarity in sphalerite in cases where both minerals were found intergrown. In addition, the polarity effect on epitaxial growth of chalcopyrite on sphalerite was established.

Light-figure reflections obtained from mechanical etch pits developed in chalcopyrite were also used to establish new microcleavage planes in the mineral.

CRYSTAL-CHEMICAL CALCULATIONS

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Methods are indicated for calculating: (i) the stoichiometry of multicomponent isomorphous variants (e.g., complex silicate minerals), (ii) the number of oxygen atoms in the unit cell, (iii) the unit-cell dimension of a cubic isotope from several known members of the same series, and (iv) the unit-cell volume of a non-isometric substance from the volume of a single known isotype. Any physical characteristic that will lead to a calculation of the density can be used as a basis for calculating other scalar properties, such as the refractive index (for an isotropic substance). When the analogies are close, predictions are often within 2% of experimental results.

BIOMINERALOGY: ITS APPLICATIONS

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Because of the physiological significance of diseases, and growth and repair of bone among vertebrate animals, considerable attention has been given to the biomineralization process. This process, involving both biochemistry and inorganic crystal chemistry, can be studied among more primitive phyla (invertebrates) through application of electron microscopy and diffraction. In addition to the ordinary carbonate (calcite and aragonite) hard parts, biomineralization among marine organisms produces such insoluble substances as fluorite and quartz (as euhedral crystals), but may also include soluble intratissue substances, such as NaCl. Pathological biomineralizations include numerous substances, but straightforward relations between etiology and a precise knowledge of the biominerals will be difficult to establish. Although ingestion of fluorides is known to be related to susceptibility toward dental caries, for example, the relations between crystallochemical differences and resistance to disease are not known. It is possible, for example, that the amount of chemically bound water in the carbonate apatite of dental enamel may be one of the most significant factors affecting its "stability".

APPLICATION OF THERMOLUMINESCENCE TO GEOLOGICAL PROBLEMS

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The defect conditions in the crystal lattice of some rock-forming minerals reflects certain aspects of the geological history of the rock. By utilizing various sample treat-