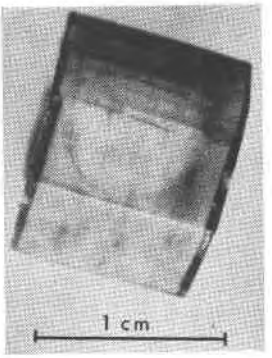

FIG. 3. Single-crystal emerald deposited on a natural beryl seed.

We wish to express appreciation to Miss Frances Woods for assistance with crystal growth and sample processing.

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TRIDYMITE (LOW FORM) IN SOME OPAL OF NEW MEXICO

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INTRODUCTION

Many opal samples from New Mexico were studied, and it was found that none of these is completely amorphous. There is always a crystalline or cryptocrystalline phase in opal. It has been pointed out by Levin and Ott (1932) that many opal samples are not amorphous as previously suggested. It may be true, however, that the original opal is precipitated as a truly amorphous substance and then is changed partly to a crystalline or cryptocrystalline phase. The most common crystalline phase is quartz.

Although cristobalite in opal has been reported in other publications, it is not found in the opal samples of this study.

Occurrences

The uranoan hyalite or opal of the San Mateo Mountains district, Sierra County, New Mexico contains 25.5 per cent calcite, both in megascopic and microscopic size, and 74.5 per cent opal. This opal contains a crystalline phase of quartz and a small portion of cryptocrystalline phase of low-form tridymite. The quartz shows a very clear *x*-ray powder diffraction pattern, although its grains are not quite discernible under the petrographic microscope. The tridymite is called cryptocrystalline because its grain size is less than 10^{-4} mm across, as indicated by the broadening of its *x*-ray powder diffraction lines.

Chert nodules are common in certain caliche beds of the Ogallala formation, Union County, New Mexico. A typical nodule is elongated in shape and has a concentric structure. It is about 10 cm long and 3 cm in diameter. The core of the nodule, 2.6 cm in diameter, is calcareous chert (porcellanite), which is composed of 75.4 per cent of quartz and opal and 24.6 per cent of calcite. The size of the interlocking grains of both quartz and calcite is about 0.004 mm. The small amount of opal in the core contains a cryptocrystalline phase of low-form tridymite. Surrounding this core is a layer of translucent opal 0.4 cm thick. The contact of the translucent opal and the porcellanite core is sharp. This translucent opal shows a bright yellow-green fluorescent color under short-wave ultraviolet light. Its water content is 7.73 per cent, and its index of refraction is 1.443 ± 0.002. This translucent opal contains cryptocrystalline low-form tridymite.

Identification

The identification of the low-form tridymite is based on the comparison of its *x*-ray powder diffraction data (Table 1) with the data of low-form tridymite in the ASTM *X*-ray data file. Hill and Roy (1958)

Table 1. *X*-Ray Powder Diffraction Data of Low-Form Tridymite in Opal, Ogallala Formation, Union County, New Mexico

d (Å)	I	d (Å)	I
4.29	6	1.613	4
4.10	10	1.443	2
2.50	7	1.463	2
2.08 band	1	1.251	1
2.05 band	2	1.202	1

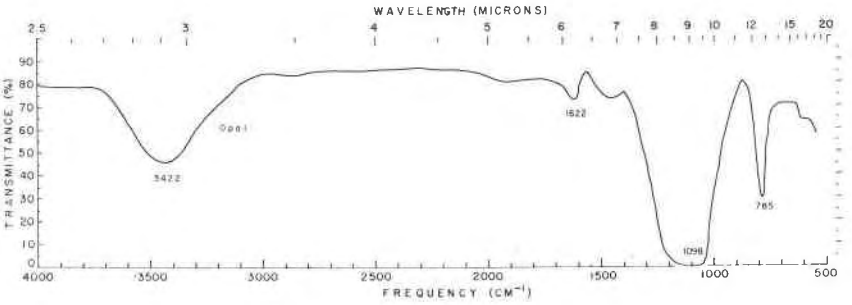

FIG. 1. Infrared spectrum of opal, Union County, New Mexico.

identified three phases of high temperature tridymite in their study on tridymites: the unstable tridymite that is characterized by two weak powder diffraction lines at 3.95 and 3.85 Å; the metastable tridymite that is characterized by one weak powder diffraction line at 3.82 Å; and the stable tridymite that is characterized by two weak powder diffraction lines at 3.92 and 3.83 Å. None of these high-temperature forms of tridymite is found in the opal samples of New Mexico.

INFRARED ABSORPTION DATA

The infrared spectrum of the translucent opal of the chert nodule from the Ogallala formation is shown in Fig. 1. It is characterized by a broad absorption band at 3422 CM^{-1} (2.92μ), a band at 1622 CM^{-1} (6.17μ), a small band at 1462 CM^{-1} (6.84μ), a very strong band at 1098 CM^{-1} (9.11μ), and a sharp band at 785 CM^{-1} (12.74μ).

The absorption band at 3422 CM^{-1} is due to the O-H stretching vibration of "water molecules hydrogen bonded to each other and to SiOH groups" (McDonald, 1958, p. 1170). The absorption band at 1622 CM^{-1} is due to the O-H stretching vibration of the absorbed water. The small band at 1462 CM^{-1} is probably extraneous. The strong band at 1098 CM^{-1} is assigned to the stretching vibration of Si-O. The sharp band at 785 CM^{-1} has no assignment.

The infrared spectrum is obtained from a Perkin-Elmer 421 grating spectrophotometer with NaCl prism. One mg of opal and 300 mg of KBr are used to form a KBr pellet at 18,000 psi pressure.

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