GEOLOGY 409

MINERALOGY OF THE SLOCAN ORES

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April 9, 1948

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ILLUSTRATIONS

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ABSTRACT

The primary mineral appears to be pyrite followed by several periods of fracturing and movement, each time with an injection of quartz. In these fissures, sphalerite, tetrahedrite and pyargyrite, chalcopyrite and galena were deposited in turn. Carbonates usually terminated the deposition. Values are carried by galena and tetrahedrite, and by silver minerals, of which pyargyrite is the most important.

INTRODUCTION

In view of its economic importance in the past and its possibilities in the future, further study of the samples from the Slocan mining district is always of value. The area lies in the south eastern part of the province, in the eastern part of the Selkirk Mountains, immediately west of the Purcell trench. It includes parts of Slocan, Slocan City and Ainsworth Mining Divisions. The topography is typically alpine with the region centering ~~with~~ upon an east-west transverse valley between Kaslo, on ~~the~~ Kootenay Lake, and New Denver, on Slocan Lake. To the north, the Lardeau Mountains parallel the valley while the Slocan Mountains border it on the South.

The ores of the district are an intimate mixture of argentiferous galena, sphalerite, tetrahedrite, pyrite, chalcopyrite and silver minerals in a gangue of quartz, siderite and calcite, being chiefly valuable for silver, and secondarily for lead and zinc, with small amounts of gold. Samples of a typical "dry" ore (silver being the only important mineral) were obtained from the Hewitt Mine, located southeast of Silverton. This property was discovered in 1892 and has shipped ore since 1900. Up until 1934 the mine had produced 93,000 tons of ore averaging 14 ozs. of silver, 1% lead, and 18% zinc, per ton. At the present time exploration work is proceeding on the ore body.

Samples of "wet" ore (silver, lead and zinc equally important) came from the Ivanhoe and Silversmith Mines southwest of Sandon. The Ivanhoe was located in 1893 and produced ore from 1895 to 1905 and from 1913 to 1921 averaging 9 ozs. silver and 6% lead per ton. The Silversmith is the second largest producer in the district. An offshoot of the Slocan Star lode, it was located in 1917, producing until 1926 some $6,000,000 from 300000 tons of ore containing 10.7 ozs silver, 4% lead and 2% zinc, per ton. Gold in the amount of 878 ozs was also recovered.

GENERAL GEOLOGY

The geological formations of the Selkirk Mountains vary in age from Late Pre-Cambrian to Tertiary (?). In the Slocan area the most important are the Slocan Series and the post-Triassic intrusives. A sedimentary group of rocks of Triassic age, the Slocan Series consists of slate, argillite, limestone, quartzite and tuffaceous sediments. The Series continues to the north but is cut off on the south by a batholithic intrusion which has subjected the sediments to varying degrees of metamorphism, both thermal and dynamic.

Cutting the sediments is a complex of intrusive rocks related to the Nelson Batholith which is associated with, and cut by, younger differentiates. The rocks consists of various types of granite, granodiorite and diorite, and are post-Triassic in age.

The contract between the Slocan Series and the Nelson Batholith has a general easterly strike with a number of broad flexures imposed on the sedimentary formations parallel to the contact. In addition there has been a general regional Cordilleran deformation with a north-easterly trend. This gives an overall picture of many dome and basin-shaped folds complicated by numerous faults, shear zones, overturned folds and locally, intensely contorted strata.

The mineralization was chiefly in the form of fissure vein deposits with some replacement, depending upon the character of the enclosing rock. The mineralizing solutions are attributed to the Nelson Batholith and followed this period of intrusion.

The Hewitt Mine has part of its workings in the Nelson granite while the Ivanhoe and the Silversmith are located in the Slocan sediments near minor intrusions.

MINERALOGY

Galena

The most abundant ore mineral, galena usually occurs in well defined crystals, notable for their regular triangular pitting. It is associated with every other mineral, particularly chalcopyrite and tetrahedrite, and usually carries minor amounts of tetrahedrite and silver. In some cases (Section 3) galena shows distinct flow lines, formed as the mineral was being deposited.

Sphlalerite

Almost as abundant as galena, the sphalerite is usually massive, a rich brown in colour with well defined cleavage. Where massive, it has usually been replaced along its edges by other sulphides but,where shattered,gives excellent samples of fissure filling by gangue minerals (drawings I-2 and V111-4).

Pyrite

Probably the oldest of the ore minerals and now found only as scattered remnants throughout the other sulphides, pyrite is usually didtictive in its regular diamond and cube-shaped crystals. These crystals are found through large areas of altered Slocan sediments. The mineral may carry silver in the form of tetrahedrite admixed.

Chalcopyrite

Chalcopyrite is found in most of the ores but not in sufficient quantities to be valuable. In the sections it is usually found as tiny blebs along the contact between galena and the other minerals. Often fingers of galena extending into other minerals are terminated in similar fingers of chalcopyrite (drawings II-2 and III-1).

Tetrahedrite

This mineral forms the principal constituent of "dry" ores and, as a rule, carries an important amount of silver. It may occur as tiny scattered lumps throughout the galena (section III).

Pyrargyrite

Pyrargyrite is the most abundant silver mineral and is usually associated with tetrahedrite. When ~~associated~~ found scattered through tetrahedrite (section VI), potassium-cyanide gives a remarkable selective etch.

Quartz

This mineral is the predominant gangue in "dry" ores. Usually milky white and massive, it may form regular euhedral crystals filling cavities. Later minerals tend to fill the irregular openings around these crystals as illustrated in Sections VI and IX. In other cases the later quartz fills fractures in the metallics, as shown in most of the sections.

Carbonates

In the sections studied no attempt has been made to differentiate the various carbonates and all have been reffered to as "calcite". Actually, honey-yellow to black siderite is the most important in "wet" ores, with calcite wide spread and barite fairly common. As the mineral which has been deposited last, the carbonates usually occur filling fractures in all of the metallic and gangue minerals.

PARAGENESIS

The drawings following were specially chosen to illustrate the order of mineralization in that particualr section. Although they may, in themselves, not prove the order given beside the drawing, they are indicative of general conditions in the section and the order given applies to that section. Some of the relationships were not definitely proven because the minerals involved were not in contact, but the order was set down as seemed indicated.

The following table shows the minerals present in each section, this being the general order in which they were noted. None of the orders as determined in the individual sectionss conflicted with the overall order.

TABLE I

MINERALS PRESENT IN THEIR ORDER

Mineral	Section 1	2	3	4	5	6	7	8	9
Pyrite	x		x	x	x				
Quartz						x			
Sphalerite	x	x	x	x	x	x	x	x	x
Quartz									x
Tetrahedrite		x	x			x			x
Pyrargynite						x			x
Quartz		x	x	x	x		x	x	
Galena	x	x	x	x	x	x	x	x	x
Chalcopyrite	x	x	x	x					x
Quartz	x	x							x
Calcite		x						x	x

Apparently, pyrite and quartz were the first minerals deposited. They must have had a chance to precipitate leisurely because euhedral crystals of both are common, especially with the quartz filling vugs and cavities, as shown in section VI. This would seem to indicate a fracturing of the pyrite and a filling of the fissures by quartz, although this is shown in only the one section.

Probably at the same time in most places, sphalerite filled the fractures in pyrite and probably replaced it in part. The sphalerite in turn was highly fractured and in some places at least, (section IX), was filled with quartz. In most cases, however, the next mineral to be deposited was tetrahedrite, and contemporaneous with it, pyrargyrite. Thus, they are found filling fractures in sphalerite and quartz and replacing sphalerite as well.

At this point more quartz seems to have been introduced, followed by galena and chalcopyrite filling fissures in all the minerals previously deposited, and also replacing most of them. The chalcopyrite occurs as small blebs along the borders of galena and as the terminations of fingers of galena into other minerals. Cairnes (see bibliography) attributes this to chalcopyrite being disseminated throughout the sphalerite and congregating in greater amounts along contacts where sphalerite is being intruded by other minerals. ~~However~~, Chalcopyrite, however, seems to occur just as commonly

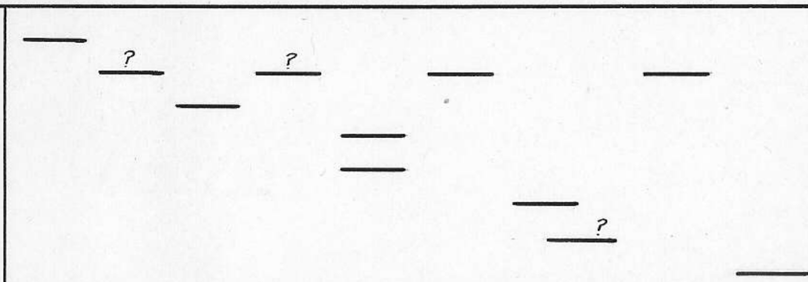
~~as commonly~~ scattered in galena, and certainly occurs in many places with galena where it is not in contact wih sphalerite (drawings II-1 and 2, IX-4). Also, it fills fissures in sphalerite (section IX) indicating a later deposition. For these reasons, it would seem possible that, in these sections at least, chalcopyrite could have been deposited contemporaneously with galena. ~~and~~ forming along its contacts, or perhaps, even later, replacing galena along its edges where it filled or replaced other minerals.

Following this, another period of fracturing allowed the deposition of quartz, filling fissures in galena and chalcopyrite (sections I, II and IX).

Final precipitaten in most sections was that of calcite, filling fissures in all the previous minerals, and in one instance, perhaps, even replacing galena. In Section IX the calcite and galena occupy mutual positions, such that either could be taken as replacing the other. However, a fissure of calcite definitely displaces chalcopyrite (drawing IX-3) while, in the galena, several connecting fratures filled with calcite were noted. This would seem to show that the calcite is later than galena and therefore, replacing it.

From the f oregoing remarks and observations a table showing the order of mineralization is herewith presented:

TABLE II

ORDER OF MINERALIZATION	
Pyrite Quartz Sphalerite Tetrahedrite Pyrargyrite Galena Chalcopyrite Calcite	

EXAMINATION OF SECTIONS

FROM THE

SILVERSMITH, HEWITT AND IVANHOE MINES

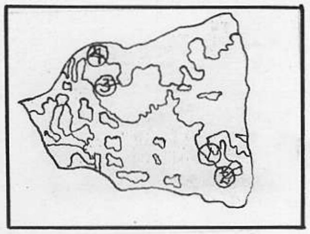
LEGEND

- Galena
- Sphalerite
- Pyrite
- Chalcopyrite
- Tetrahedrite
- Pyrargyrite
- Quartz
- Calcite

Field of View = 1800 Microns.

SILVERSMITH MINE

SECTION NO 1

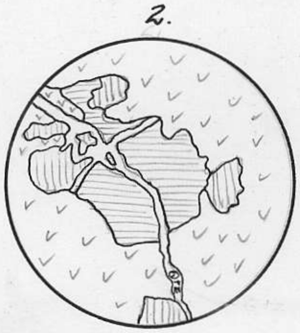


1.

Py, Sph

Gal, Chal

2.

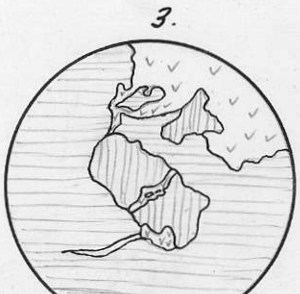


Py, Sph

Gal

Qtz

3.



Py

Sph

Gal, Qtz

4.

Py

Sph

Qtz, Gal, Chal

Pyrite

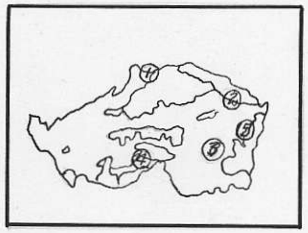
Sphalerite

Galena, Chalcopyrite

Quartz

SILVERSMITH MINE

SECTION NO 2



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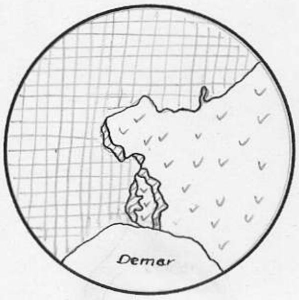
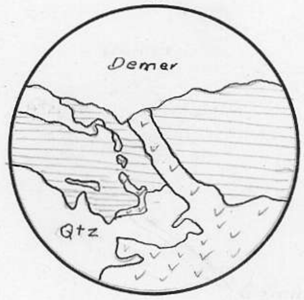


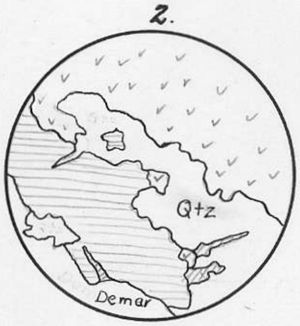
Tetra
Gal
Chal

4.



Sph
Qtz
Gal

2.

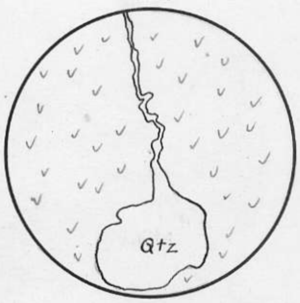


Sph
Qtz
Gal
Chal

5.

Sph
Gal, Qtz
Chal
Calc

3.

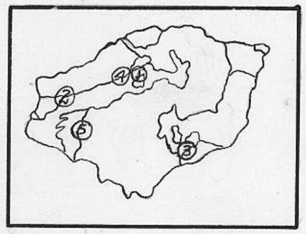


Gal
Qtz

Sphalerite
Tetrahedrite
Quartz
Galena
Chalcopyrite
Quartz, Calcite

SILVERSMITH MINE

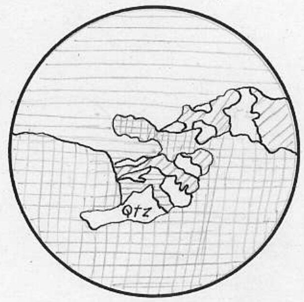
SECTION NO 3



1.

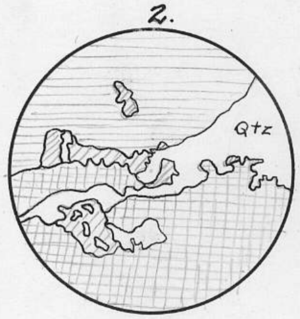
Sph
Gal
Chal

4.



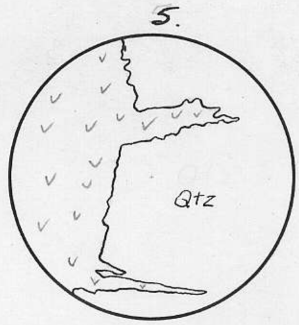
Sph
Tetra
Qtz, Chal

2.



Tetra, Sph
Qtz
Chal

5.



Qtz
Gal

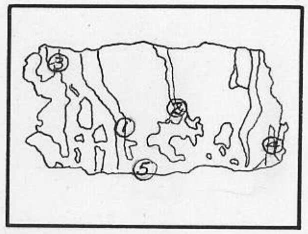
3.

Py, Tetra
Qtz
Chal

Pyrite, Sphalerite
Tetrahedrite
Quartz
Galena Chalcopyrite

SILVERSMITH MINE

SECTION NO 4



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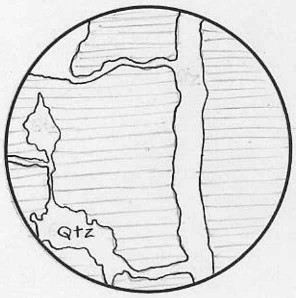


Sph
Qtz

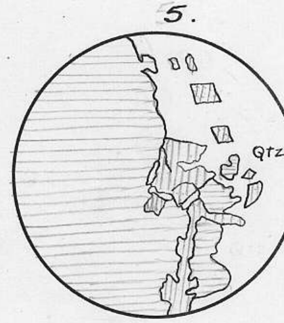
4.

Sph
Qtz
Gal, Chal

2.

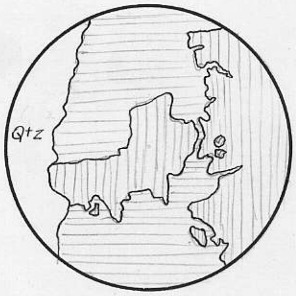
Sph, Py
Qtz
Gal

5.



Py
Sph
Qtz

3.

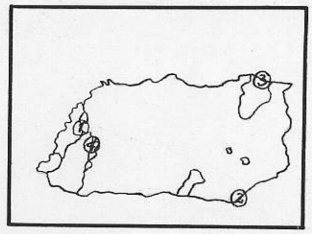


Py
Sph, Qtz

Pyrite
Sphalerite
Quartz
Galena, Chalcopyrite

HEWITT MINE

SECTION No 5



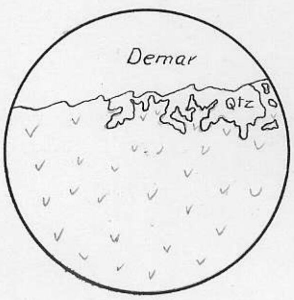
1.

Py, Sph
Qtz

4.

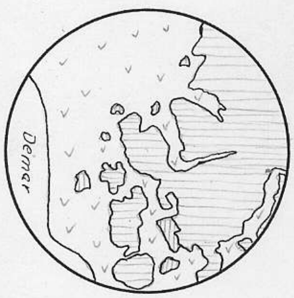
Py
Sph, Qtz
Gal

2.



Qtz
Gal

3.

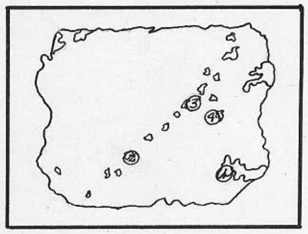


Py, Sph
Gal

Pyrite
Sphalerite
Quartz
Galena

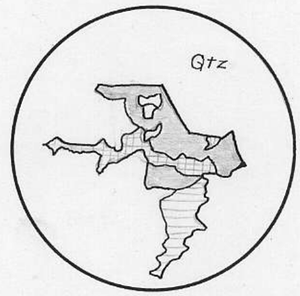
HEWITT MINE

SECTION No 6

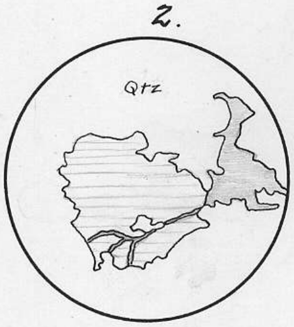


1.

4.



2.



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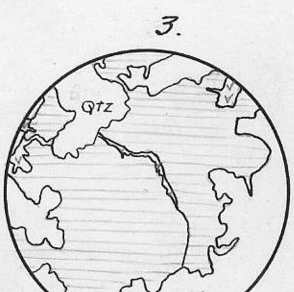
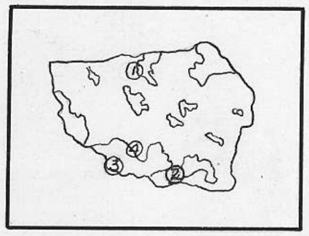


Quartz
Sphalerite
Tetrahedrite, Pyrargyrite, Galena

HEWITT MINE

SECTION NO 7



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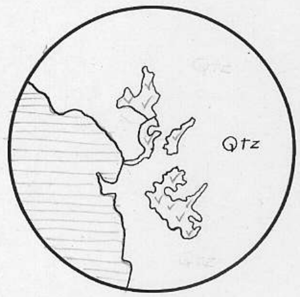
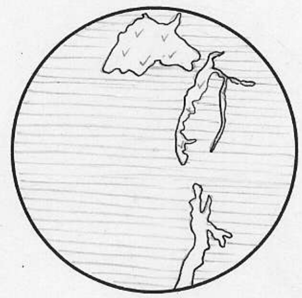


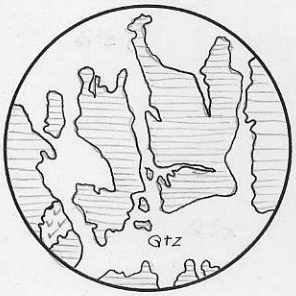
Sph
Qtz
Gal

4.



Sph
Qtz, Gal.

2.



Sph
Qtz, Gal

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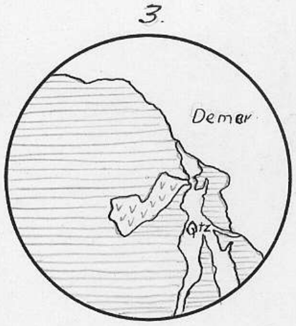
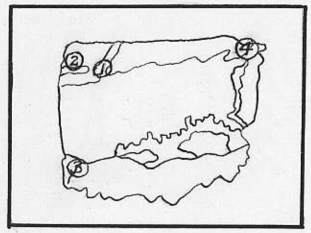


Sph
Qtz, Gal

Sphalerite
Quartz
Galena

IVANHOE MINE

SECTION No 8



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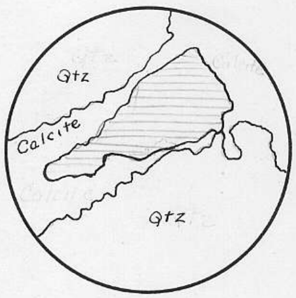
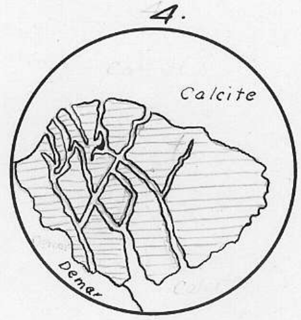


Sph, Qtz
Calc

4.



Sph
Calc

2.

Sph
Qtz

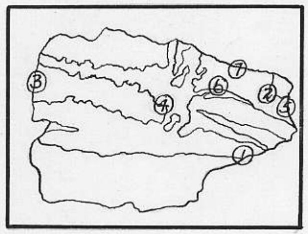
3.

Sph, Gal
Calc

Sphalerite
Quartz, Galena
Calcite

IVANHOE MINE

SECTION No. 9



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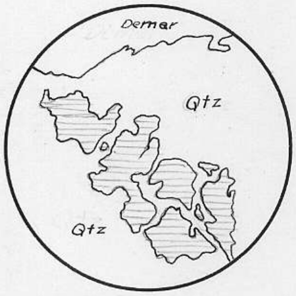
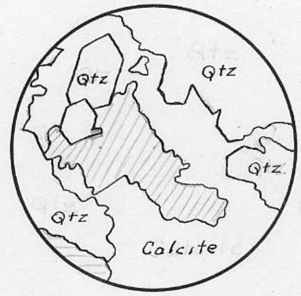


Sph
Qtz

4.



Sph
Qtz
Chal
Calc

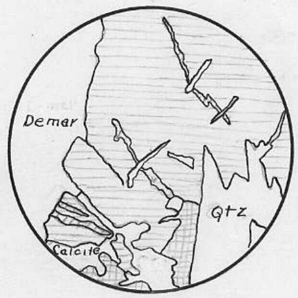
7.

Sph
Qtz
Tetra, Pyrarg
Chal

2.

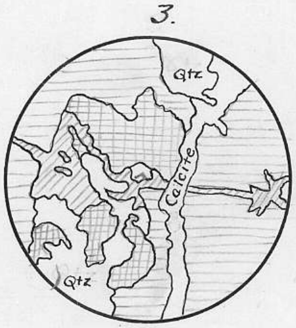
Sph
Tetra, Qtz
Gal, Chal

5.



Sph
Gal, Chal, Tetra
Qtz, Calc

3.



Sph
Tetra, Qtz, Chal
Calc

6.

Sph
Qtz
Tetra, Chal

Sphalerite
Quartz
Tetrahedrite, Pyrargyrite
Galena, Chalcopyrite
Quartz
Calcite

BIBLIOGRAPHY

Cairnes, C.E.: Slocan Mining Camp, British Columbia; Geol. Surv., Canada, Memoir 173, 1934.

" Description of Properties, Slocan Mining Camp, British Columbia; Geol. Surv., Canada, Memoir 184, 1935.

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