State of Oregon
Department of Geology and Mineral Industries
910 State Office Building
1400 SW Fifth Avenue
Portland, Oregon 97201

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PRELIMINARY ANALYSIS OF FOUR SESCA SAMPLES FROM THE GORDA RIDGE

by

John Wiltshire,
Gary McMurtry,
and Ned Murphy
Hawaii Institute of Geophysics, University of Hawaii

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NOTICE

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Some Preliminary Conclusions on the Temporal Extent of Hydrothermal Activity

Four samples were analyzed from the SESCA site located at 40° 45'N in the Escanaba Trough. These samples were taken by the submersible SEA CLIFF on dives 662 and 663. The samples were analyzed for Fe, Ba, Pb, Zn, Cu, ^{234}Th, ^{228}Ra, ^{226}Ra and ^{210} Pb. Resulting ages of formation were calculated. These ages were further interpreted using mineralogical data (from x-ray diffraction) and the weathering state of the sample.

The SESCA site is a broad low uplift in the center of the Southern Escanaba Trough. In consists of three circular hills rising about 100 m from the valley floor (Fig. 1). Seismic surveys indicate that the three hills are the expression of a volcanic intrusion. The sediment thickness reaches over 500 m in the SESCA area. This means that any hydrothermal fluid rising from the vicinity of an igneous intrusion is likely to be strongly influenced by the sediment column. There are a series of faults and fissures surrounding the bases of the three hills. These are likely ring faults related to the igneous intrusive events. Most of the sulfides are in rubble mounds along the edges of the hills.

Of the four samples analyzed, two were recovered from the northern SESCA hill and two were recovered from the central 3170 hill. Table 1 shows the mineralogy of these samples. They are all pyrrhotite-rich with minor accessory Cu, Zn, Pb and Fe sulfides. Several of the samples contain significant amounts of barite. All of the samples appear weathered, but not equally. The samples from dive 663 are very friable and extremely weathered, those from dive 662, less weathered. All of the samples were picked up from rubble mounds or as broken chimney fragments.

Figure 1

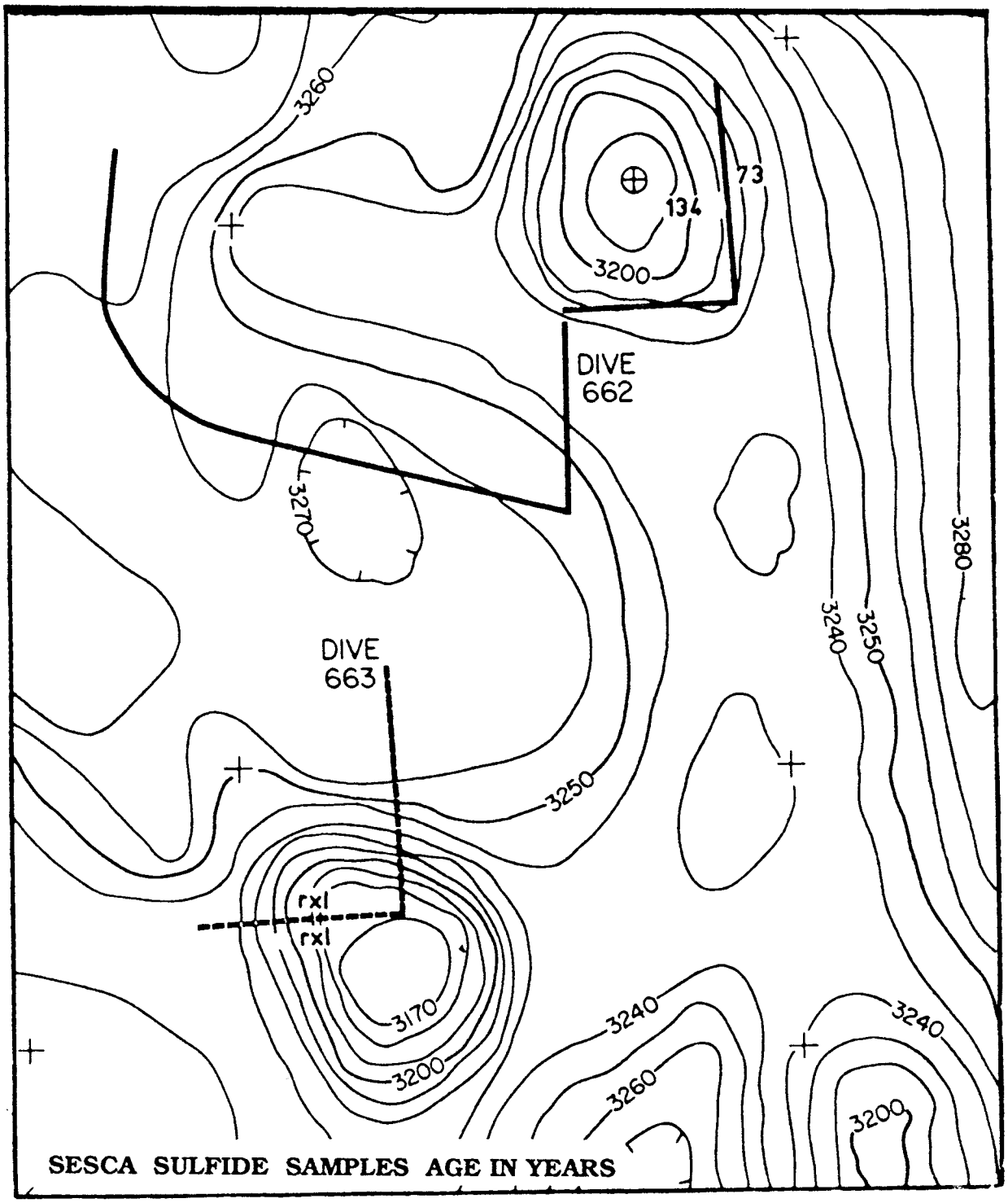
3260
73
134
3200
DIVE
662
3270
3280
3240
3250
DIVE
663
3250
rxl
rxl
3170
3200
3240
3260
3240
3200
SESCA SULFIDE SAMPLES AGE IN YEARS

Table 1

Sample Description and Mineralogy

Sample Number	Nature of the Sample	Major Minerals	Minor Minerals
662 R1-B	chimney fragment	Pyrrhotite	Sphalerite Chalcopyrite Talc
662 R1-Fr	chimney fragment and sulfide rubble	Pyrrhotite	Sphalerite Chalcopyrite Pyrite Barite
663 R1	loose, highly weathered sulfide rubble	Pyrrhotite	Galena Sphalerite iron oxyhyroxides
663 R2	loose, highly weathered pumice-like sulfide rubble	Pyrrhotite	Barite iron oxyhyroxides

The iron sulfide-rich mineralogy is consistent with a reduced pressure and temperature associated with a highly fractured hydrothermal fluid pathway. Minor amounts of Cu, Pb, and Zn sulfides indicate that these metals are being picked up through the sediment column although they are probably deposited largely below the sediment-water surface before pressure and temperature are reduced due to cold seawater influx along the fractures. This postulated reduced temperature and pressure as well as the formation of the rubble piles themselves were probably caused by the ring fracturing. The barite present in several of the samples may be an indication of the final phases of venting with a fluid chemistry transition to a more sulfate-rich phase. This would support the contention that venting may either be finished or be in a quiescent stage at SESCA.

The ^{210}Pb age data and associated chemical abundances are presented in Table 2. This data generally supports the inferences made on the basis of the sample descriptions and mineralogy. The samples from dive 663, from the 3170 hill show considerable ^{210}Pb. Unfortunately, because of their highly weathered state, they are recrystallized preventing the calculation of an accurate age of formation. The dive 662 samples from the northern hill vary in time of formation from 73 to 135 years ago. It is assumed that the dive 663 samples are older than this, based on weathering state and iron oxyhydroxide formation.

These preliminary data shed some light on hydrothermal activity at the SESCA site. The site was clearly active for a period of at least 60 years, as recently ago as 73 years. Higher sediment covers, no active venting and no evidence of recent sheet or pillow flows (as are found at NESCA) support the view that there has been no more recent activity than this. The highly weathered dive 663 samples probably indicate that hydrothermal activity was taking place for a considerable time

Table 2

Chemical and Radiochemical Abundances of SESCA Samples

	662 R1-B	662 R1-Fr	663 R1	663 R2
Pb (%)	0.11	0.29	4.11	2.83
Zn (%)	2.12	1.89	0.58	0.79
Fe (%)	50.51	41.78	40.65	40.17
Ba (%)	0.32	5.89	0.55	1.11
Cu (ppm)	11,200	8,300	2,400	<25 ppm
^{234}Th	1.06	3.85	17.91	23.31
^{234}Th error	±0.06	±0.14	±0.17	±0.33
^{228}Ra	0	0.028	0	0
^{228}Ra error	0	±0.017	0	0
^{226} Ra	3.11	51.53	7.14	11.51
^{226} Ra error	±0.03	±0.19	±0.05	±0.11
ratio ^{228}Ra/^{226}Ra	0	0.0006	0	0
^{210}Pb	2.52	45.96	13.40	19.78
^{210}Pb error	±0.28	±1.16	±0.46	±0.63
Excess ^{210}Pb	-0.59	-5.57	6.26	8.36
Excess ^{210}Pb error	±0.28	±1.18	±0.47	±0.63
Age	73 years	135 years	re-crystallized	re-crystallized

Radionuclide data are in units of dpm/g.

before the 135 year old event. The most recent phase of SESCA activity then likely lasted considerably more than 60 years.The sulphate present in several of the samples may be indicative of the final stages of a hydrothermal phase. The iron-rich material and minor amounts of Cu, Pb and Zn suggest possible deposition of higher amounts of these more valuable sulfides at greater depths in the sediment column. SESCA is clearly not responding the same hydrothermal events as are found at NESCA only 15 miles north where active venting is now underway.

These conclusions are very tentative in nature. Four samples are clearly insufficient for any final conclusion. However, given the considerable observational data backing up these analyses, some bounds to the duration of SESCA hydrothermal activity can at least be postulated. Further sampling and sample analyses should fill in the gaps in this preliminary assessment.