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The Lake Keowee Earthquake of February, 1986

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At 06:35 EST (1135 UTC) on February 13, 1986, a shallow earthquake of local magnitude 3.2 shook northwestern South Carolina near Lake Keowee and was felt as far east as Greenville. At least two aftershocks were felt within two hours of the main shock. These events were located in an area where previous earthquakes had occurred including a swarm of events in 1977.

Main Shock

Using stations of the Duke Power, Tennessee Earthquake Information Center, Georgia Institute of Technology, and U.S. Geological Survey - University of South Carolina networks and a velocity model for the Jocassee region as modified by Stihler (1985), the event was located with the computer algorithm HYP071 (Lee and Lahr, 1972) at $34^{\circ}47.77'N$ latitude and $82^{\circ}55.62'W$ longitude. The calculated origin time was 11:35:46 UTC. The epicenter was located in the vicinity of High Falls church, west of Lake Keowee and approximately 2.5 kilometers from the Oconee Nuclear Station as shown in Figure 1. The magnitude was obtained from the durations at stations of South Carolina network.

Aftershocks

Portable seismographs were deployed in the epicentral area early on February 14 and monitored until February 19, when it was determined that activity had diminished. Using stations of the Jocassee network until portable data were available and incorporating the two data sets, over 75 aftershocks with

durations over 3 seconds were recorded. The largest aftershock recorded was of magnitude 2.1 (February 13, 1625 UTC). Three events were of magnitude 2.0 (February 13, 1207 and 1733 UTC; February 16, 0426 UTC), 11 had magnitudes between 1.0 and 2.0, and the remaining events were small ($M_L < 1.0$). A total of 13 aftershocks were locatable, a summary list is given in Table 1. The better locations were of B quality (Lee and Lahr, 1972) with epicentral uncertainties of approximately 0.5 km and depth uncertainties of about 1.0 km. These aftershocks clustered in the High Falls church area (Figure 1) within 5.0 km of the surface.

Previous Activity

The epicentral area defined by the current activity was the site of a shallow earthquake swarm in January - February, 1978 (Talwani *et al.*, 1979). The largest events of that swarm were of local magnitude 2.2. Activity was more intense then, with up to 200 recorded events per day. These were not the first earthquakes felt here. Talwani *et al.* (1979) summarized previous activity in this area including the "Seneca" earthquake of July 13, 1971 (MM Intensity IV) and a poorly located event on December 13, 1969 (MM Intensity V).

Summary

An earthquake with a duration magnitude of 3.2 occurred at 1135 UTC and was located at $34^{\circ} 47.77'N$ latitude and $82^{\circ} 55.62'W$ and was followed by multiple aftershocks with magnitudes ranging

to $M_L = 2.1$. Portable seismographs were deployed and shallow aftershocks were located within two kilometers of the main shock.

References

Lee, W.H.K., and Lahr, J.C. HYP071: A computer program for determining hypocenter, magnitude, and first motion pattern of local earthquakes, *U.S. Geol. Surv. Open File Report*, 100pp., 1972.

Stihler, S.D. Seismic refraction, anisotropy and seismicity in South Carolina, MS thesis, University of South Carolina, Columbia, SC, 102 pp., 1985.

Talwani, P., Stevenson, D., Amick, D., and Chiang, J. An earthquake swarm at Lake Keowee, South Carolina, *Bull. Seis. Soc. Am.*, **68**, 825-841, 1979.

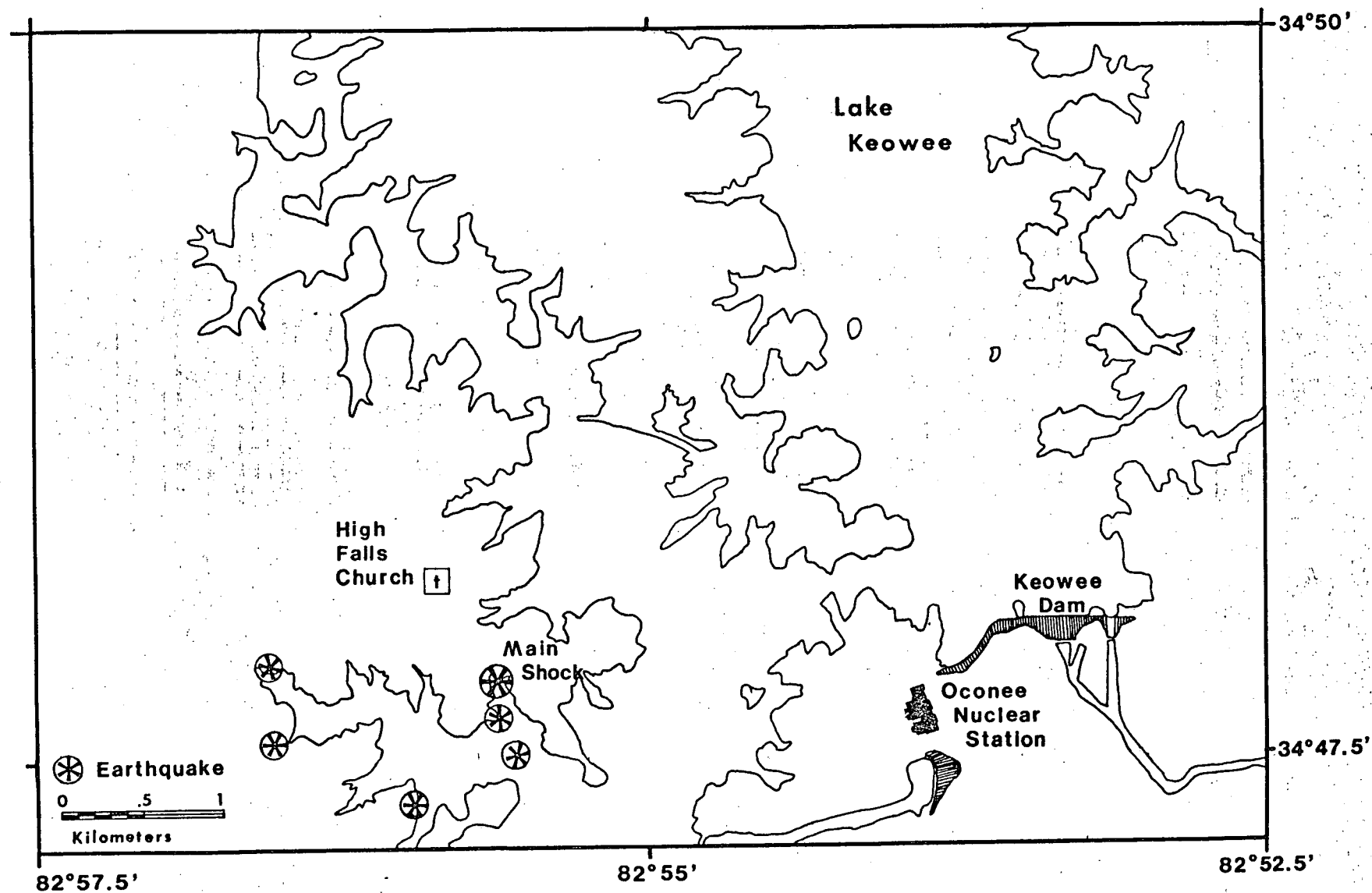


Figure 1.

Table 1. Summary list of located earthquakes at Lake Keowee, South Carolina, February, 1986.

DATE	ORIGIN	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	QM		
860213	1135	45.93	34-47.77	82-55.62	1.92	3	22	15	148	15.5	0.10	0.6	13.6	C1
860214	642	17.69	34-49.52	82-55.13	1.38	15	220	7.6	0.58	1.4	45.0	01	01	01
860214	1026	17.52	34-47.94	82-55.26	2.82	6	220	4.3	0.04	0.7	1.4	01	01	01
860214	1847	39.40	34-47.46	82-55.09	0.89	6	221	4.0	0.07	6.3	10.2	01	01	01
860215	134	33.74	34-47.51	82-55.44	2.98	10	153	4.2	0.04	0.0	0.8	01	01	01
860216	426	4.33	34-47.35	82-55.95	2.80	6	185	3.9	0.07	1.1	3.4	01	01	01
860216	430	18.11	34-48.94	82-55.13	4.74	6	99	5.9	0.06	1.1	0.0	01	01	01
860216	11	99	48.96	82-55.04	4.74	6	99	5.9	0.06	1.1	0.0	01	01	01
860216	15	8	8.34	82-55.77	1.00	6	99	5.9	0.04	1.1	0.0	01	01	01
860216	15	8	26.16	82-55.61	2.75	6	99	5.9	0.05	1.1	0.0	01	01	01
860217	122	21	40.00	82-55.77	5.76	6	99	5.9	0.05	1.1	0.0	01	01	01
860217	122	21	40.00	82-55.77	5.76	6	99	5.9	0.05	1.1	0.0	01	01	01
860217	122	21	40.00	82-55.77	5.76	6	99	5.9	0.05	1.1	0.0	01	01	01
860217	122	21	40.00	82-55.77	5.76	6	99	5.9	0.05	1.1	0.0	01	01	01
860217	2215	41.21	34-47.33	82-55.70	1.05	0	265	8.8	0.08	2.8	6.1	01	01	01

ATTACHMENT 2

EARTH TREMOR INTENSITY WITNESSES

Earth Tremor Intensity Witnesses

February 13, 1986 Event

- 1) Sandra H. Smith, resides in Wolkstake Community, approximately 2.2 miles NNW of epicenter, heard and felt tremor, but nothing in home moved or rattled.
- 2) Charles R. Harrison, resides in Salem, S. C., approximately 7.2 miles north of epicenter, did not hear or feel tremor.
- 3) Charles E. McSwain, resides near Salem, S. C. approximately 8.8 miles north of epicenter, heard tremor, but did not feel anything.
- 4) Alan Langhans, resides near Lake Jocassee, approximately 12 miles north of epicenter, heard and felt tremor and noted some glasses on shelf rattled slightly.

ATTACHMENT 3

TYPICAL SEISMOGRAM