



EXPLANATION

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| Reservoir symbol | Maximum Richter magnitude of induced earthquakes |
| ▲ | > 5.5 |
| ▲ | 3.0-5.5 |
| ▲ | < 3.0 |
| ● | Magnitude not reported |
| • | No reported seismicity |
| △ | Open symbol indicates equivocal relationship of seismicity to impounding |

Histogram showing observed frequency percentages of reservoirs associated with impoundment-induced seismicity (earthquake magnitudes ≥ 3) within certain water-depth intervals, which percentages are taken as the best estimate of mean probability (includes the three equivocal cases). The light lines are 95% confidence limits of the probability estimates assuming a binomial distribution (Clopper and Pearson, 1934). The lines are dashed where rough estimates were made for the large number of reservoirs in the lower depth classes. The association of seismicity with impoundment is questionable for two reservoirs considered seismic in the 90-120 m depth category, and one in the 150-250 m depth category.

This plot included all large reservoirs ($\geq 10^8 m^3$ water capacity) listed in the World Registry of Dams (International Commission on Large Dams, 1973), identifying those reportedly associated with impoundment-induced seismicity. Reservoirs not associated with such seismicity are not plotted if the reservoir is less than 90 m deep and less than $10 \times 10^8 m^3$ capacity because the total number in that range exceeds several hundred; only four (<1%) of these are associated with seismicity greater than Richter magnitude 3. About 40 to 45 reservoirs have been reported as associated with seismicity of any magnitude (Simpson, 1975; Castle and others, written comm., 1976; Gupta and Rastogi, 1976); some reservoirs with associated seismicity <3 are below the size plotted here. Forty to 45 reservoirs represent 0.4% of the approximately 11,000 large dams listed in the World Registry of Dams; if only the reservoirs with associated seismicity ≥ 3 are counted, it is less than 0.2%. However, the percentages become significant for deep reservoirs (see also the histogram). Fourteen percent of all reservoirs >95m water depth are associated with seismicity ≥ 3 magnitude, 11% if the 3 reservoirs equivocally associated with seismicity are omitted. The single Chinese reservoir for which we have any data is plotted to show its depth, capacity, and the seismic magnitude, but is not included in the statistical summaries because no other Chinese reservoirs were included in the World Registry of Dams. For those reservoirs for which the figures were not available, the water depth was estimated from the dam foundation height.

Reservoir	Reference
1. Oroville, USA	Bufe and others, 1975
2. Vajont, Italy*	Catoli, 1966; Rothé, 1970, 1973; Božović, 1974
3. Kurobe, Japan	Hagiwara and Ohtake, 1972
4. Talbingo, Australia	Simpson, 1975; Muirhead and others, 1973
5. Nourek, USSR*	Nikolaev, 1974
6. Canelles, Spain	Rothé, 1970; Božović, 1974
7. Montyard, France	Rothé, 1969, 1970, 1973
8. Schlegeis, Austria	Blum and Fuchs, 1974
9. El Grado, Spain	Rothé, 1973
10. Vouglans, France	Božović, 1974; Simpson, 1975
11. Oued-Fodda, Algeria	Božović, 1974; Rothé, 1970; Gupta and others, 1973
12. Grandval, France	Rothé, 1969, 1970; Gupta and others, 1973
13. Bajina Bašta, Yugoslavia	Božović, 1974; Simpson, 1975
14. Parambikulam, India*	Guha and others, 1974; Gupta and Rastogi, 1976
15. Sholayar, India	Guha and others, 1974
16. Marathon Lake, Greece	Carder, 1970; Božović, 1974
17. Cajuru, Brazil	Brito, 1974
18. Flathead Lake, USA	Rothé, 1973; Gupta and Rastogi, 1976
19. Mula, India	Guha and others, 1974; Gupta and Rastogi, 1976
20. Lake Meridith, USA	Castle and others, written comm., 1976
21. Fallsades, USA	Schleicher, 1975
22. Hendrik Verwoerd, South Africa	Gupta and Rastogi, 1976; Green, 1973
23. Hsinfengkiang, China	Wang and others, 1975
24. Mangla, Pakistan	Brown, 1974; Adams, 1974
25. Eucumbene, Australia	Carder, 1970
26. Koyna (Lake Shivajisagar), India	Gupta and Rastogi, 1976
27. Lake Benmore, New Zealand	Adams, 1974
28. San Luis, USA	Carder, 1970; Mickey, 1973
29. Grandžarevo, Yugoslavia	Božović, 1974
30. Kremasta, Greece	Cominakis and others, 1968; Therianos, 1974
31. Shasta, USA	Carder, 1970
32. Lake Mead, USA	Carder, 1970; Anderson and Laney, 1975
33. Lake Kariba, Zambia/Rhodesia	Gough and Gough, 1970

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This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature.

IMPOUNDMENT-INDUCED SEISMICITY ASSOCIATED WITH LARGE RESERVOIRS

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