We made measurements of peak asbestos air concentrations in the breathing zone of drywall construction workers, utilizing the standard technique of the National Institute for Occupational Safety and Health (NIOSH) for asbestos sampling and analysis (phase-contrast optical microscopy at $\times$ 430) (*5*). These air samples were also analyzed by transmission electron microscopy. Air samples were taken at various building jobs and job sites and included such operations as hand-sanding, pole-sanding, mixing of dry spackle with water, and sweeping after completion of such operations. Personal air samples were also taken in adjacent areas; such air samples, taken in the breathing zones of the operators, constitute measurements of their exposure to dust.

Table 2 shows that airborne concentrations of 5 fibers per milliliter of air or more, longer than 5 μm, are common during the use of drywall taping compounds containing asbestos. This exceeds the interim legal standard excursion set by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor. The OSHA standard calls for an 8-hour time-weighted average. The discontinuous nature of these operations suggests that the 8-hour sampling is inappropriate in that peak exposures in the present instance, under a range of application and cleanup operations, greatly exceed the maximum allowable excursions of 10 fibers per milliliter for a 15-minute interval.

These concentrations, determined by the NIOSH method, are only suggestive of the total asbestos exposure. Comparison of optical microscopic and electron microscopic analyses of asbestos fiber counts of identical samples showed that, for every fiber visible by light microscopy ($\times$400 magnification), there were from 200 to almost 1000 that could be seen only at electron microscopic magnifications of $\times$25,000.

The background measurements in Table 2 suggest that in home repair work involving sanding of spackling compounds, members of the entire household or other occupants of a building may inhale asbestos fibers. This could occur during mixing, sanding, or cleaning up of debris. During mixing of drywall taping compounds, spackle is gradually poured from a bag into a bucket of water and the mixture is stirred until the desired consistency is attained. Fiber counts measured during mixing were found to be from 7 to 12 times greater than the current occupational standard. Detectable fiber concentrations were found in adjacent rooms during mixing, and fibers were still suspended in the room air at least 15 minutes after mixing had ceased. Personal air samples were taken after sanding was completed. The floors of the rooms and halls were swept with a hand broom, which raised a cloud of dust. Fiber counts could not be made on floor sweeping samples because the filters were too heavily laden to count. Samples were taken after 15 minutes had elapsed, and, in one case, 15 m away in another room. Measurements showed that significant concentrations of asbestos remained suspended and could pervade living quarters for a considerable duration of time after sweeping had ceased.

In summary, our analysis of 15 representative samples of consumer spackling, patching, and taping compounds has shown that five contained appreciable amounts of chrysotile or other asbestos minerals. Many contained substantial amounts of quartz, talc, and other minerals with disease potential. Optical microscopic analysis of personal air samples obtained during the use of asbestos-containing compounds showed concentrations frequently in excess of the current occupational standard of 5 fibers per milliliter, longer than 5 μm. Use of these materials in home repair work (for example, mixing, sanding, and cleanup) may expose the user (and other members of the household) to significant concentrations of asbestos.

Even more important, none of the 25 industrial and consumer spackling and taping compounds examined had warning labels or indication that they might contain toxic or hazardous materials. It is, therefore, recommended that potentially toxic or hazardous materials be eliminated from consumer spackling, taping, and wall-patching compounds as soon as feasible. As an interim measure, labels should be required on such products stating their content and providing instructions for the use of appropriate respirator protection and for safe cleanup procedures, including the disposal of waste materials.

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7 March 1975

Water Wells as Possible Indicators of Tectonic Strain

Abstract. *Coseismic water level changes associated with the Izu-Hanto-oki earthquake of 9 May 1974 were recorded in 59 among 95 observation wells located in the districts of Tokai and Kanto, Japan. The spatial distribution of wells in which the groundwater level rose or fell is rather systematic. The areas in which these wells are located closely coincide with the areas of contraction and dilatation expected by the faulting. This strongly suggests a possible correlation between the observed changes in groundwater level and the tectonic strain. The results may indicate that the water level of wells is able to monitor at least acute coseismic strain changes.*

A destructive earthquake occurred on the southern tip of the Izu Peninsula, Japan, at 08:33 hours on 9 May 1974. The seismological data (*1*) are: epicenter, 34° 34′N, 138°48′E; depth of focus, 10 km; and magnitude, 6.9. The focal mechanism of the earthquake was a quadrant type with the maximum pressure axis in a nearly north-south and horizontal direction. Distinct earthquake faults appeared along the preexisting, dextral strike-slip faults trending in a northwest-southeast direction (*2*).

Coseismic changes in groundwater level caused by the earthquake were examined in 95 observation wells (*3*), located 50 to 210 km from the epicenter. These wells were drilled originally for the protection of groundwater resources and measurement of land subsidence. Most of the wells range in depth from 100 to 300 m, the shallowest and the deepest being 35 and 2150 m deep, respectively. Groundwater level changes were continuously monitored, in most cases, with recorders manufactured by the Nakaasa Sokki Co. The practical sensitivity of these instruments for detecting changes in water level is estimated to be no greater than 4 mm.

Of the 95 wells examined, 59 showed a more or less steplike water level change at the time of the earthquake. A step caused by mechanical malfunction was experimentally found to be smaller than 1 cm of water level change. The observed steps in water level were about 2 to 20 cm, depending mainly on the characteristics of individual wells and roughly on the epicentral distance of the wells. The records of the wells located closer to the epicenter showed oscillation, with an amplitude up to 30 cm, at the time of the steplike change. Three examples of the recorded water level changes are shown in Fig. 1.

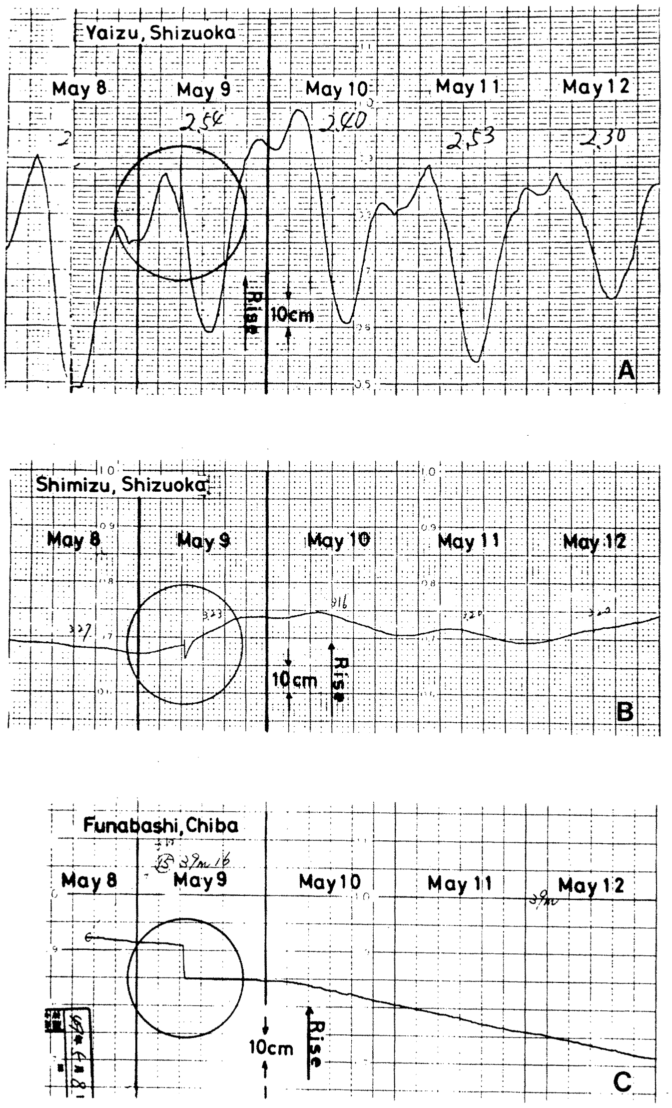

Fig. 1. Three examples of water level records (3). (A) A 150-m-deep well at Yaizu, Shizuoka; epicentral distance, about 50 km. Tidal fluctuations and a coseismic water level rise of 10 cm are observed. (B) A 138-m-deep well at Shimizu, Shizuoka; epicentral distance, about 56 km. The water level shows a coseismic fall of 5 cm. (C) A 250-m-deep well at Funabashi, Chiba; epicentral distance, about 160 km. No coseismic oscillation of water level is recorded, but a 12-cm fall of water level is seen.

Apparent fluid pore pressure changes during fault creep events have been studied in a 152-m-deep well drilled into the San Andreas fault zone (4). Many workers have noted groundwater level changes caused by earthquakes (5), including the great Alaska earthquake of 1964 (6). However, the tectonic significance of the observed changes has not been fully appreciated.

Altogether 95 records were collected, and 10 were discarded because of poor recording quality. The spatial distribution of the 59 wells that showed a coseismic rise and fall of water level and the 26 wells that showed no significant changes during the earthquake is shown in Fig. 2.

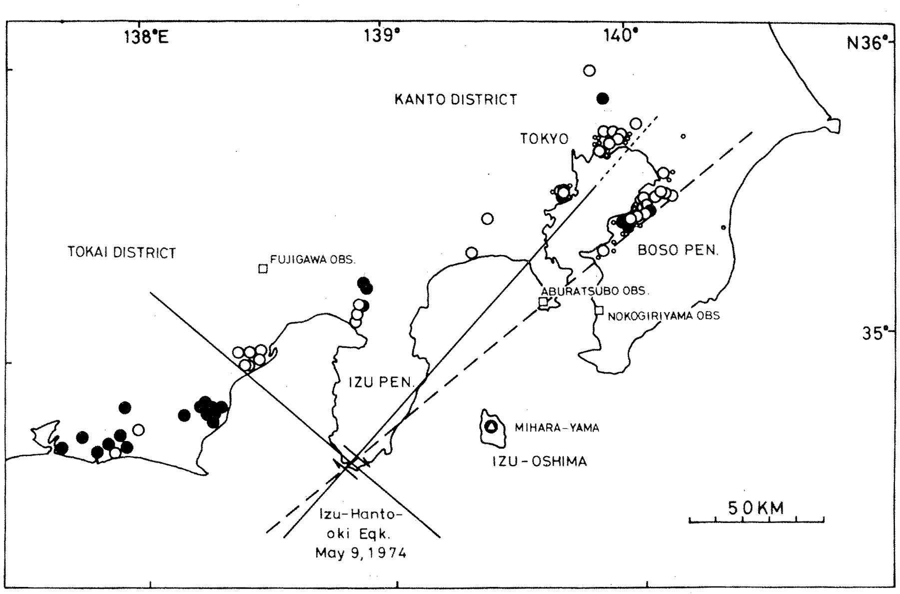

Fig. 2. Spatial distribution of 85 wells in which groundwater level was monitored at the time of the 1974 Izu-Hanto-oki earthquake; 59 of the wells showed water level changes. Closed circles indicate wells that showed a rise in water level and open circles indicate wells in which water level fell. Smaller circles, 26 in number, indicate wells that did not show any coseismic change in water level. Solid lines are nodal lines derived from the focal mechanism of the earthquake (1); the northwest-trending one represents the extension of the actually displaced fault, the sense of which is indicated by a pair of arrows. The dashed line shows the preliminary southeastern limit of the area of water level fall.

The distribution is rather systematic, suggesting a regional significance, although there are some exceptions. Of the three lines in Fig. 2, the two perpendicular solid lines in the northwest and northeast directions are nodal lines derived from the focal mechanism of the earthquake (1). The dashed line with a northeast-southwest direction is a tentative limit of the area of water level fall.

The spatial distribution of wells in the western area is sharply differentiated by the northwest-trending nodal line which is the extension of the actual fault. In the eastern area, the wells that showed coseismic fall of water level are located slightly beyond the other nodal line. This disagreement remains to be investigated.

The sectors of water level rise and fall nearly coincide with those of contraction and dilatation caused by the earthquake faulting. This coincidence strongly suggests a tectonic strain origin for the observed coseismic change in groundwater level.

No water level data were available for the eastern contraction area. The only well we could examine there is located on the east coast of Boso Peninsula (Fig. 2), has a depth of 1520 m, and showed no significant change in water level. In this same area of contraction the Izu-Oshima volcano is located. The rise of magma level in the conduit of Mount Mihara-yama, Izu-Oshima, observed at the time of the Izu-Hanto-oki earthquake was attributed to the tectonic strain effect, or magma squeezed up from the reservoir (*7*). It may also have been caused by crustal phenomena similar to those discussed above. Additional support for these arguments comes from observations at Shimogamo hot spring and its vicinity, in the eastern contraction area of the Izu Peninsula, where a significant rise in the level of the hot spring and increase in water discharge were reported after the earthquake (*8*).

Three crustal movement observatories at Fujigawa, Aburatsubo, and Nokogiriyama, which are 70 to 110 km from the epicenter, are distributed within the area of present concern. At Fujigawa Observatory, the station nearest the epicenter, the strain steps on three components of the strainmeter showed the extension ranging (1 to ~ 6) $\times 10^{-8}$ (*9*). However, no significant changes in strain were observed at other stations.

It is rather surprising that wells less than 60 m deep could reflect tectonic strain, and further research is needed to confirm this. A more detailed discussion and description of the data will be published elsewhere.

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6 March 1975

Oxygen and Carbon Isotopes from Calcareous Nannofossils as Paleoceanographic Indicators

Abstract. *Oxygen-18 and carbon-13 analyses of well-preserved calcareous nannofossils have been compared with those of foraminifera contained in Cenozoic cores collected in the Southern Ocean during the Deep Sea Drilling Project. The results indicate that calcareous nannofossils deposit calcium carbonate at or near equilibrium with oceanic surface waters and that they can be used as paleotemperature indicators.*

Calcareous nannofossils, principally Coccolithophoridae, a group of marine phytoplankton, are major contributors to pelagic sediments. They are widely used both in biostratigraphic age determinations and as paleoceanographic indicators (*1*) because of their rapid evolutionary changes, habitat, and apparently higher resistance to dissolution than planktonic foraminifera, as evidenced by their abundance in fossil carbonate sediments (*2, 3*). They have not, however, been the subject of any detailed stable isotope studies. We have determined $\delta^{18}O$ and $\delta^{13}C$ values (*4*) from calcareous nannofossils contained in three sediment cores collected in the Southern Ocean during Leg 29 of the Deep Sea Drilling Project (DSDP) and compared these data with similar published ones (*5*) for associated planktonic and benthic foraminifera contained in the same samples. The purpose of this comparison is to determine whether calcareous nannofossils preserve $\delta^{18}O$ and $\delta^{13}C$ values consistent with their euphotic habitat (*3*) or undergo exchange with bottom or interstitial waters during or after burial.

The Leg 29 cores (*5*) are well suited for such a study as they represent a relatively continuous sequence spanning the last 55 million years (*6*) and contain a well-preserved calcareous fauna and flora deposited at depths between 1200 and 3300 m. During this time interval, profound changes in the configuration, circulation patterns, and temperature structure of the Southern Ocean occurred (*7, 8*), and extensive ice sheets developed on Antarctica (*5, 7, 9*).

Relatively pure but polyspecific calcareous nannofossil fractions consisting of isolated coccoliths, coccospheres, and discoasters were separated from the fraction of samples < 44 μm from the three cores by using short centrifuge techniques (*10*), and each sample was checked for purity of nannofossil content and state of preservation by scanning electron microscopy. Values of $\delta^{18}O$ and $\delta^{13}C$ for calcareous nannofossils were determined by using standard mass spectrometer techniques (*11*).

The $\delta^{18}O$ profile for calcareous nannofossils (Fig. 1) closely parallels the foraminiferal profiles for most of its length, including intervals of rapid change of apparent temperature in the late Cenozoic and at the Oligocene-Eocene boundary. Nannofossil $\delta^{18}O$ values are occasionally slightly higher than those of associated planktonic foraminifera, indicating either differential isotope (vital) fractionation during growth or postmortem reequilibration produced by dissolution or secondary encrustations within sediments (*12*). However, none of our nannofossil $\delta^{18}O$ values are as high as those of the colder-water benthic foraminifera, which would indicate complete isotopic exchange with bottom waters. The majority of nannofossil samples from site 277 exhibit $\delta^{18}O$ values that are equal to or slightly lower than those of the planktonic foraminifera, indicating that the nannofossils are apparently preserving surface water temperatures.

The $\delta^{13}C$ profile for calcareous nannofossils (Fig. 2) also shows a tendency to parallel the foraminiferal curves. The progressive increase in $\delta^{13}C$ values from the benthic and planktonic foraminifera to the nannofossils at sites 279A and 277 suggests that carbon isotopes reflect the $\delta^{13}C$ of the surrounding media and may be indicative of the water depth during growth (*13*). The $\delta^{13}C$ of the ΣCO_2 in present-day South Pacific waters varies from about $+2.0$ per mil at the surface to around $+0.5$ per mil in bottom waters (*14, 15*).

The effects of dissolution and secondary encrustation with resultant isotopic reequilibration of calcareous nannofossils should be related to either water depth or subsequent burial history. At the present time planktonic foraminifera show slight dissolution effects below 1000 m, with appreciable dissolution occurring below 3000 m in the Central Pacific. Etching, fragmentation, and dissolution features are evident on coccoliths found below 3000 m, and further deterioration increases rapidly below 4000 m. Overgrowths are most prevalent on coccoliths deposited between 3500 and 4800 m and apparently can be produced at or near the sediment-water interface (*16*). Among the cores studied here, only sediment samples from site 279A now lie below a water depth of 3000 m and should contain the most evidence for dissolution. The isotope data from site 279A (3341 m), when compared with sediments from sites 277 and 281 (1214 and 1591 m), do not support such a depth-dependent reequilibration model.