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The Pollution of Okinawa Main Island's Yakata Tideland BY Akatsuchi

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1. Introduction

Pollution caused by akatsuchi is in a critical state in the sea surrounding the southwestern islands of Japan that include the Okinawa prefecture. Akatsuchi, or Kunigami Mahji, is an acidic red soil that is widely spread all over Okinawa. The pollution of the coral sea around the islands are said to have started with the sudden and fast paced land developments and excavations that began in 1950.

Many researches and studies of the akatsuchi pollution has been done (i.e. Ohmija, 1985; Okinawa Department of Health and Environment, 1981; Onaga, 1974). Assessments of the amount of akatsuchi that has accumulated and spread out in the coral sea, however, have not been done sufficiently. The amount of akatsuchi that flows into the sea from rivers, something that needs to be analyzed even before any assessments are done, has likewise, not been analyzed.

The reason for this lack of information is that most of the past studies done on akatsuchi either surveyed only a few points around the mouths of rivers or they were done only once a year in a careless manner.

By surveying several points in a wide area continuously, this research attempts to get a better look at the akatsuchi that has accumulated and spread out in the coral sea. The area of the coral sea that was surveyed in this research is the Yakata Coast of Onna Village.

This coastal area is also called the Yakata Katabaru by the local people, meaning the Yakata Tideland, or Yakata Tidal Flat. Even though the area where the river flows into the sea, the drainage basin, at the Yakata Coast is mostly covered by forests, the corals in this area is said to be mostly destroyed due to sea pollution caused by land developments and excavations.

2. Location and Methods of the Field Survey

The Yakata Tideland is a large tidal flat that stretches out on the Yakata Coast located on the northern part of Okinawa Main Island (Fig.1). The coral reef here extends two kilometers from the coast and most of it is above water during low tides. The tidal range here is approximately two meters.

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The drainage basin here is mostly covered by forests and akatsuchi is widely spread about in the soil of the drainage basin. As Fig. 1 shows, a good portion of the forests here has been excavated. The area of excavation is only 7 percent of the drainage basin and the land excavations which started in 1987 had ended in 1993.

Survey points were placed in a way as to cover most of the Yakata Tideland. Imagine a grid that exists on the tidal flat with the distance between each intersection anywhere from 50 to 100 meters. The survey points were placed on each of these imaginary intersections. Survey points within 100 meters of the coastline were placed 50 meters apart while survey points beyond 100 meters of the coastline were placed 100 meters apart. Areas where the akatsuchi content of the soil was thought would increase suddenly, an extra survey point was placed between the main survey points. The soil samples taken at each survey point are first put through a sieve with 2 mm openings. Then, the soil which passed through is dissolved with a fixed quantity of solvent (3 l of water). Finally, the solution is analyzed with a photochemical turbidity meter for akatsuchi content and a calibration is calculated.

3. Survey Results

The average rainfall and wind speed for each day of the survey are given in Fig. 2. Because the coastline faces the west, winds that blew anywhere from the northeast to the south were given wind speeds of zero. This is due to the fact that only winds that cause waves would affect the accumulating and spreading of akatsuchi.

The results of the March 13, 1993 survey is shown in Fig. 3. The values shown in Fig. 3 are the percentages of akatsuchi contained in each 1 kg of soil sample. As Fig. 3 shows, areas with high contents of akatsuchi are mostly close to drainage outlets and mouths of rivers. High concentrations of akatsuchi can also be found along the navigation channel and sudden changes in akatsuchi content of the soil can be seen here. The results from the May 22 survey are shown in Fig. 4. Before the day of this survey, as shown in Fig. 2, from May 24 to 25, there had been 140 mm of rainfall. The winds on the survey day were slight breezes of less than 1.0 m/s in wind speed. In Fig. 4, almost all the survey points show 2.5% of akatsuchi content showing that the rain from May ? to ? caused a large amount of akatsuchi to flow into the area. Points where the akatsuchi content was over 2.5% start from the tip of the navigation channel, continue along the channel, and stretch out past the channel to the north. This area is used as a region for breeding marine algae during the winter. When the akatsuchi content of the area exceeds 2.5%, it is no longer usable as a breeding ground for such algae.

The results of the survey (June 3) conducted after approximately 140 mm of rainfall (May 24) are shown in Fig. 5. The percentages are somewhat lower than those of Fig. 4. The reason that the akatsuchi content of the soil is low even after a considerable amount of rainfall can be explained by studying the rainfall itself and the winds that occurred after the rainfall. As shown in Fig. 2, the winds before the survey on June 3 were quite strong with wind speeds of 2 to 3 m/s. It is deduced from this that the waves induced by these strong winds carried and moved the akatsuchi and caused a natural cleaning effect to occur in the Yakata Tideland.

Results of surveys (August 16) conducted after three typhoons had passed are shown in Fig. 6. Even though the typhoons had brought along approximately 50 mm of rainfall, the surveys show that the overall akatsuchi content in the area was very low. Results of the November 17 survey are shown in Fig. 7. Around this time of the year on Okinawa, seasonal winds (northern winds) begin to blow. Because of these winds, the soil around the corals and ocean floor became even cleaner. Also, during this time of year, the water temperature is relatively low, allowing the breeding of marine algae. As shown in Fig. 7, the akatsuchi content of the region used for breeding the algae that is north of the navigation channel has become less than 1%, making the breeding possible.

The vertical distribution of akatsuchi in the soil around the mouth of the Shimokuchi River is shown in Fig. 8. The * symbol in the illustration shows the survey point and the contour illustrations show the distribution of akatsuchi in the soil down to 50 cm. All the soil samples taken were reddish soils. Akatsuchi content becomes much greater beneath the surface than on the surface. The fact that there is an amount of akatsuchi beneath the surface that would be unimaginable just by looking at the akatsuchi content of the surface shows that a considerable amount of akatsuchi had flown into this area several years ago.

4. Conclusion

A while ago, the sunlight of a setting sun reflecting off the tideland was blinding. Today, however, the whole tideland is covered by akatsuchi and no reflection can be seen anymore.

This research achieved a better understanding of the akatsuchi pollution of the Yakata Tideland located to the north of Okinawa using careful field surveys. The surveys were conducted about once a month for a year covering 4 km² of area. The surveys also explained the annual accumulating and spreading cycle of akatsuchi that flows into the sea in the surveyed area. Finally, by analyzing the connection between akatsuchi content of the soil and wind speeds, it was discovered that the natural cleaning effects caused by wind waves has a big impact on the surveyed area. There are further plans of surveying the waves and currents of the Yakata Tideland area as well as plans for reporting the mathematical calculations.

In closing this paper, we would like to thank Futoshi Kinjo a student at the time of the surveys from the Okinawa Department of Civil Engineering and Architecture as well as Toshiyoshi Uza who is a technical officer at the University of the Ryukyus

Reference Materials

- Okinawa Environment Preservation Association (1981): Investigations of Akatsuchi Outflows (in Japanese)
- Tatsuo Ohmija (1985): Research of the Akatsuchi Pollution in Okinawa, annual report of Okinawa prefectural Institute of Health and Environment (in Japanese)
- Kenryo Onaga (1981): Development and Environmental Protection in Coastal Zones, Proceeding of the Okinawa Conference, The Importance of Bypassed Areas in Asian Economic Development, National Institute for Research Advancement, Japan Center for International Exchange (in Japanese)

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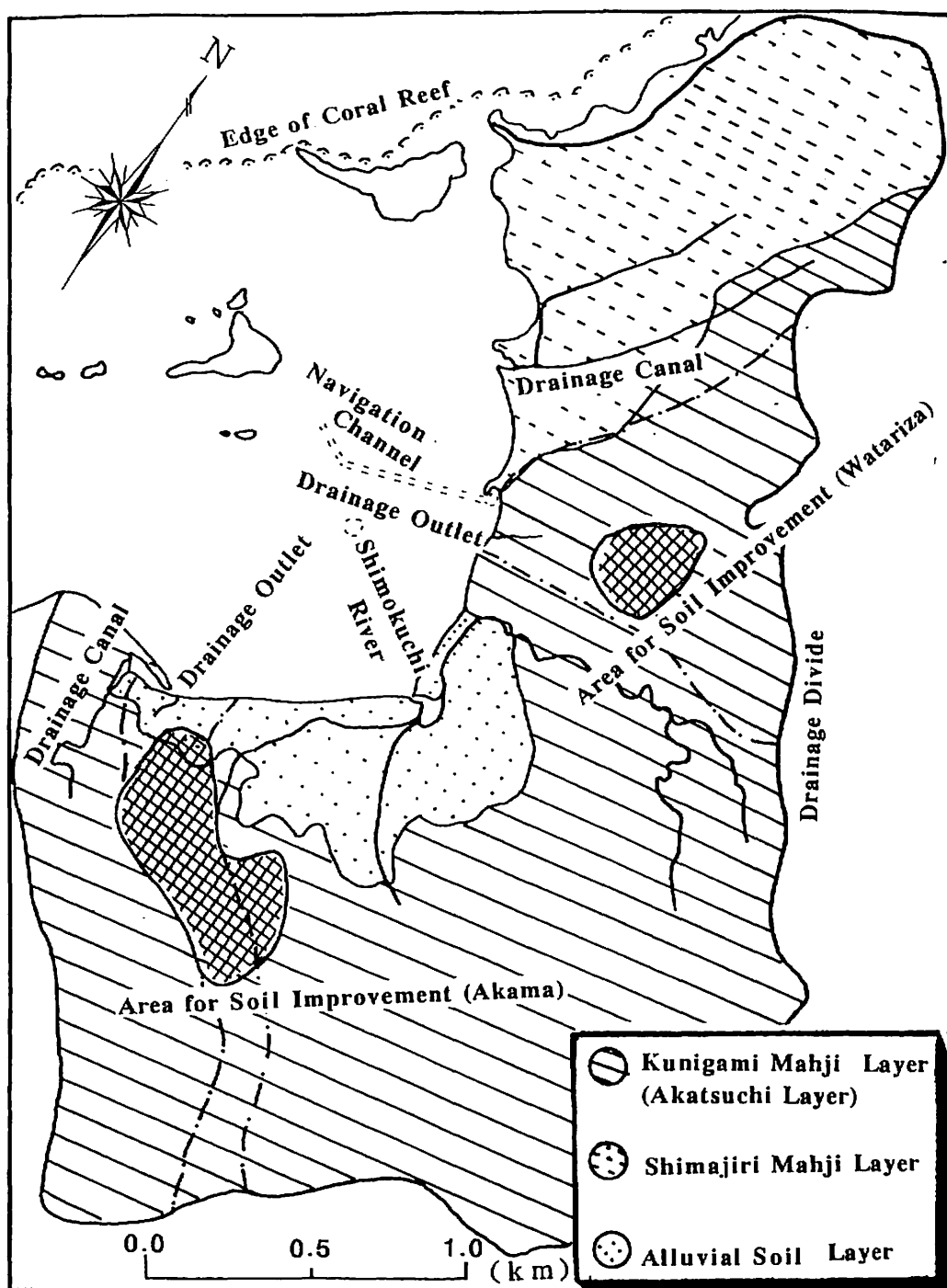


Fig. 1 Soil Distribution Map

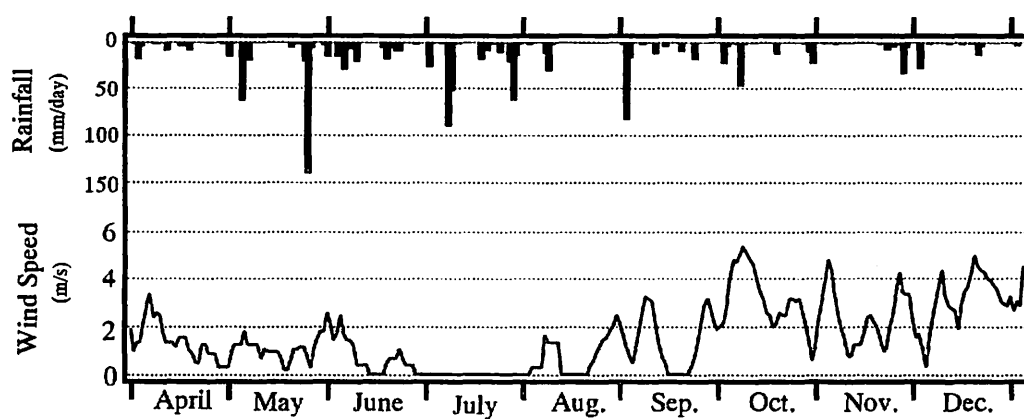


Fig. 2 Daily Changes in Rainfall and Wind Speed

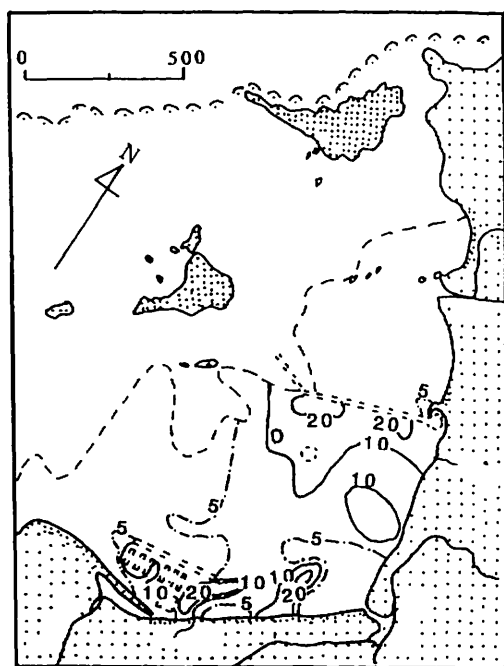


Fig. 3 Distribution of Akatsuchi content (March 13)

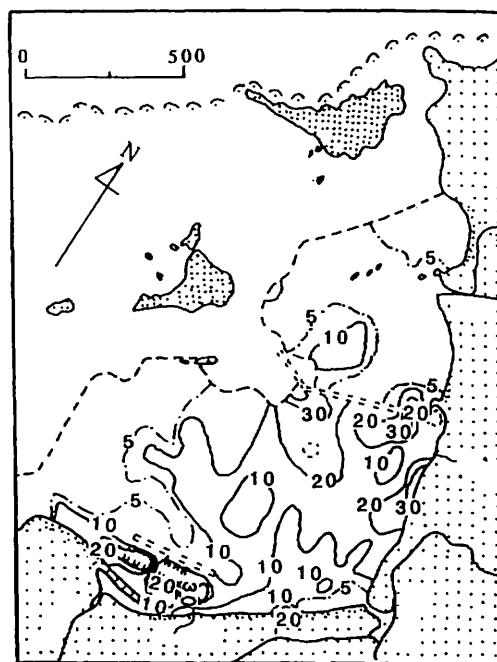


Fig. 4 Distribution of Akatsuchi content (May 22)

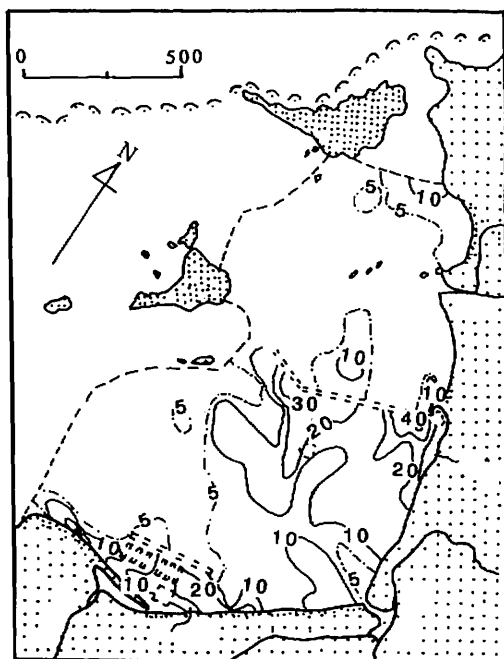


Fig. 5 Distribution of Akatsuchi content (June 3)

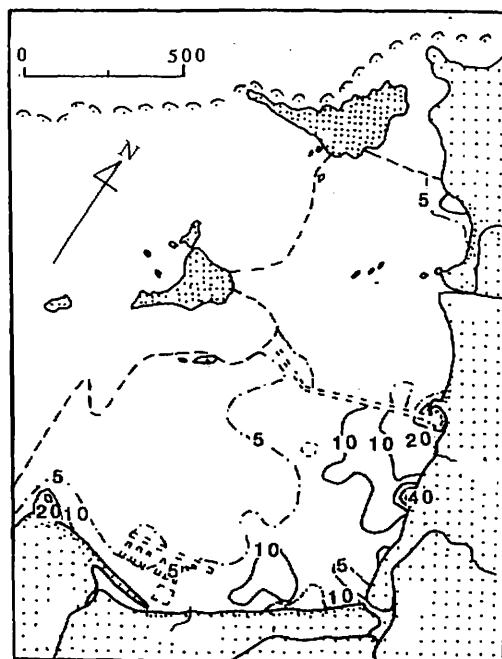


Fig. 6 Distribution of Akatsuchi content (August 16)

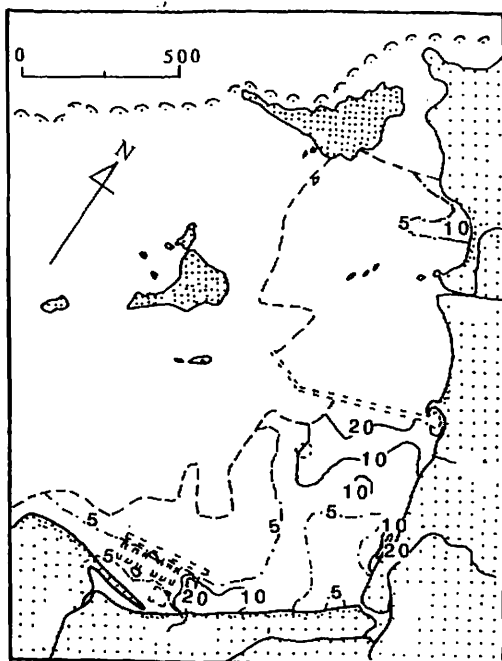


Fig. 7 Distribution of Akatsuchi content (November 17)

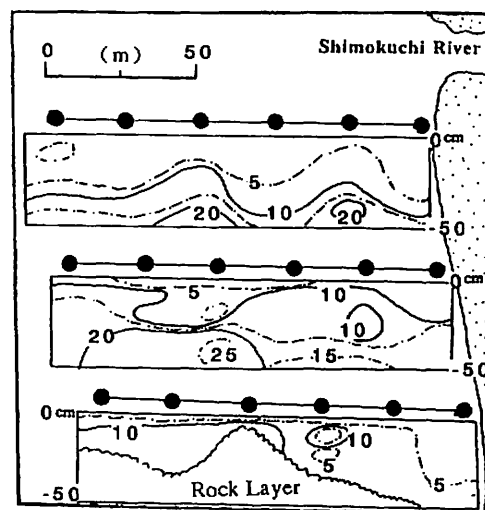


Fig. 8 Vertical Distribution of Akatsuchi