RRECENT PROGRESS OF PALEOSEISMOLOGICAL STUDY IN JAPAN—ESPECIALY ON ACTIVE FAULT STUDY

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This paper reviews recent progress of paleoseismological researches in Japan. Special attention is paid to the progress of onshore active fault study since the 1995 Hyogoken-nanbu (Kobe) earthquake. An increased number of trenching succeeds to reveal the faulting history. Nojima fault, as an earthquake surface fault, provided a rare chance for monitoring the reverse fault scarp degradation and revealed very fast degradation, compared to that of normal fault in the western USA. Paleoseismological study on offshore faults is briefly reviewed, emphasizing the recent findings of detailed submarine faults, tsunami deposits and coseismic coastal uplift, which are important tools for the estimation of repeat time of offshore faults. Some of overseas study by Japanese scientists on paleoseismological studies is also mentioned.

1. Study on onshore active fault study

Active faults, both onshore and offshore in Japan are mapped on 1:200,000 scale map with uniform standard (Research Group for Active Fault, 1880, revised in 1991). Most of major active faults are already mapped, giving fundamental information of fault distribution and other fault properties. However, still some new faults or younger displacement of Holocene surface have been found. Since the Hyogoken-nanbu earthquake (M=7.2), which resulted in a tremendous disaster in the Kobe area and Awaji Island, was originated from the known active fault (Nojima Fault), the significance of onshore active faults for the source of large earthquakes has been reevaluated in Japan. New systems for active fault study have developed in the government organization such as the establishment of Earthquake Research Head-Quarter, and of the Active Fault Research Section in Geological Survey. One of the important things to be noted is the establishment of active fault research committee in each local government, which has active faults with high slip rate. These committees are led by specialists and financially supported by Science and Technology Agency and engaged the active fault study as five-years project, including mapping, reflection method, drilling and trenching. As the result, number of trench sites is increased from 64 for 1978 to 1994, to 194 for 1995 to 1998 (Fig. 1). Increased number of trench data enable us to reconstruct the area affected by some major paleoearthquake, as in the case of 1596 earthquake in the Kinki area. Data from closely located trench sites across three subparallel faults on Miura Peninsula, southwest of Tokyo provide us the essential information on the latest faulting events and their relationships (Fig. 2). Segmentation along major Itoshizu-Tectonic Line is also discussed based on trenching data from various places (Fig. 3)..

2.Paleoseismological studies on offshore faults:

Timing and structure of some of offshore faulting are reconstructed from submarine reflection method with drilling through the bottom sediments. Tsunami deposits are recently attracted by scientists and identified at many sites, providing repeat times for major earthquakes by off shore faults. One of interesting findings is that ca.300 years ago Cascadian earthquake, estimated by geological data in the western USA, is confirmed by the historical records in Japan to be Jan. 26, 1700 (Satake et al., 1996). Coincidence of the timing of coseismic uplift and the occurrence of tsunami deposits is found in Southern Kanto. Detailed mapping of submarine active faults established the fault pattern and its relationship with onshore faults at eastern coast of Kyusyu.

3. Overseas studies on paleoseismology byJapanese scientists.

Japanese scientists also contributed to the development of paleoseismological studies in overseas both for onshiore and offshore faults.. Repeated coseismic uplift is reconstructed by a series of Holocene marine terraces in east coast of New Zealand. Repeated coseismic events in coastal area is also reconstructed from the study of late Quaternary coral terraces and paleolandslides disrupting them. Study on onshore active fauklts is also one of our targets. Japanese scientists cooperated in international team for the research of North Anatolian Fault, earthquake fault in Sakhalin, and active faults in Korea or China, for example.

The latest example is from the 921 Chi-chi earthquake, 1999. A remarkable earthquake surface fault is appeared, associated with the 921 Chi-chi earthquake (M=7.7) in central Taiwan. This earthquake fault is about 80km long, and strikes almost north-south along the boundary of the Central Range to the east, and lowland to the west. The fault is appeared as flexural scarp with upthrown side at east. The flexural scarp has a convex profile, backward tilting, back thrust and other complicated deformation on the hanging wall. Fault trace is rather sinuous, embaying toward the river mouths. These features indicate that this fault is a low angle reverse fault. The amount of vertical slip is up to ca. 9m. Critical examination on the relation of the fault traces between the earthquake fault and pre-existing active fault (Chulungpu Fault) led to the following conclusions at present: 1) The earthquake fault trace closely coincides with the pre-existing fault trace, identified by the air-photo interpretation prior the earthquake at most of the fault, 2) Even subsidiary fault as a back thrust activated coseismically, and 3) Progressive deformation is confirmed on fluvial terraces with different ages both on the main fault and back thrust. Future study on the dating of the terraces and fault events by trenching will give us important information on paleoseismology in Taiwan..

References

Okumura, K. et al (1998) Jour. Seism. Soc. Japan, Ser.2, 50, Suppl. 35-51(J+E)

Ota, Y.(1999) The Quat. Res. Japan, 38, 479-488 (J+E)

Ota, Y. and Okumura, K (1999) The Quat. Res. Japan, 38,253-261

Satake, K. et al.(1996) Nature, 379-6552, 246-249

The Research Group for Active Fault of Japan (1980) Univ. Tokyo Press (J+E)

The Research Group for Active Fault of Japan (1991) Univ. Tokyo Press (J+E)

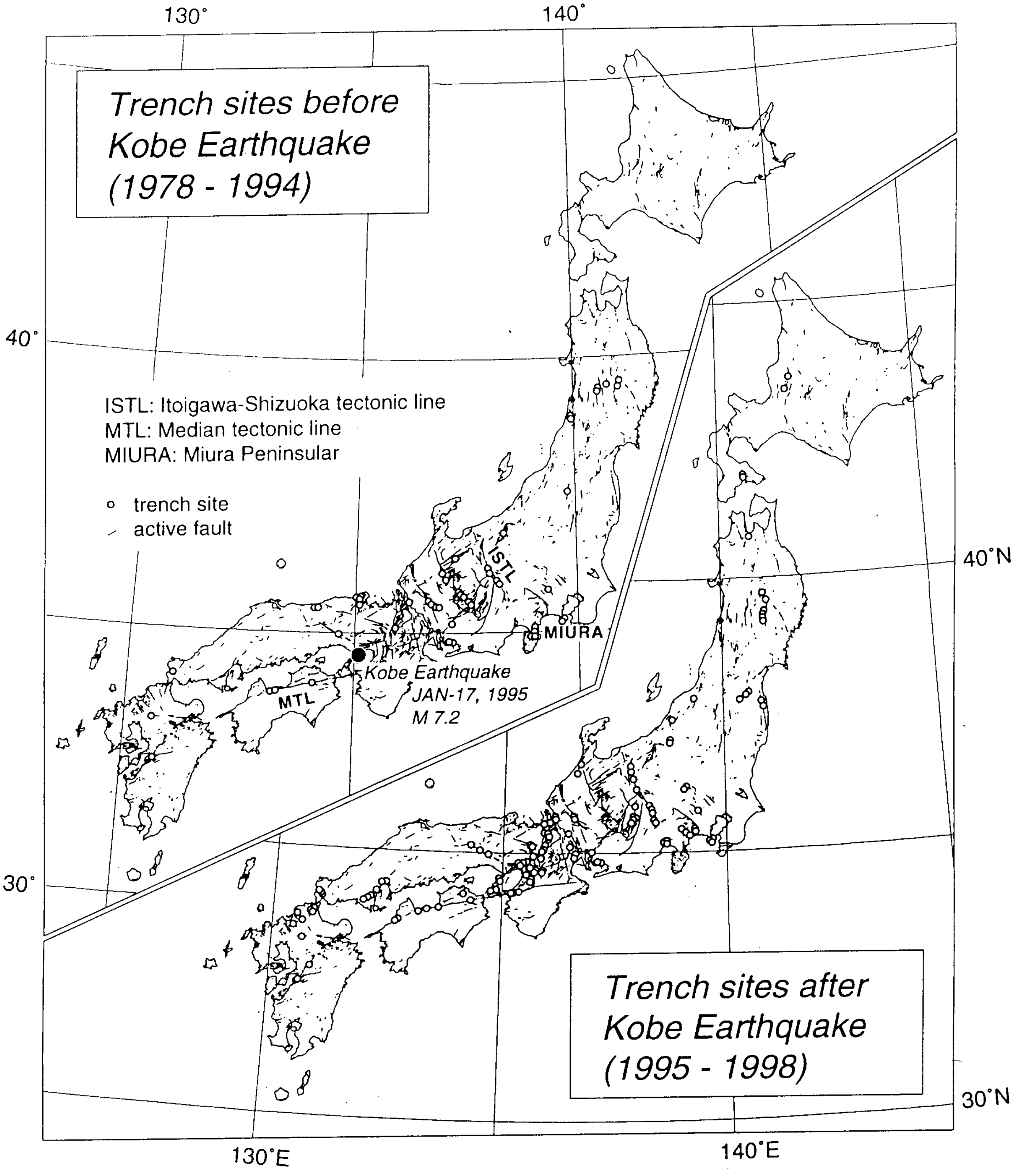

Fig.1 Distribution of major active faults and trench sites in Japan
Active faults longer than 3km are simplified from Research Group for Active Faults of Japan (1991).
Trench sites are from various sources. Closely spaced sited are represented by a single circle (Ota and Okumura, 1999).

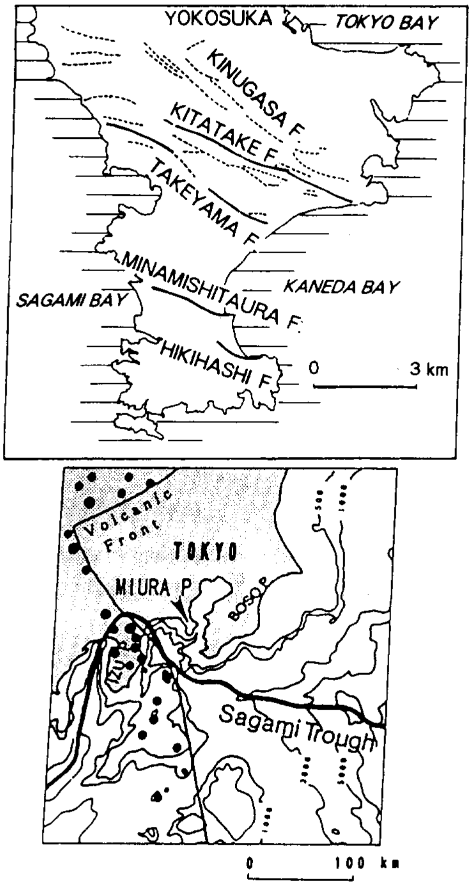

Fig. 2A Distribtion of active faults in Miura Peninsula, southwest of Tokyo Bay Inset shows the general feature in and around Sagami Bay (Yamazaki, 1993)

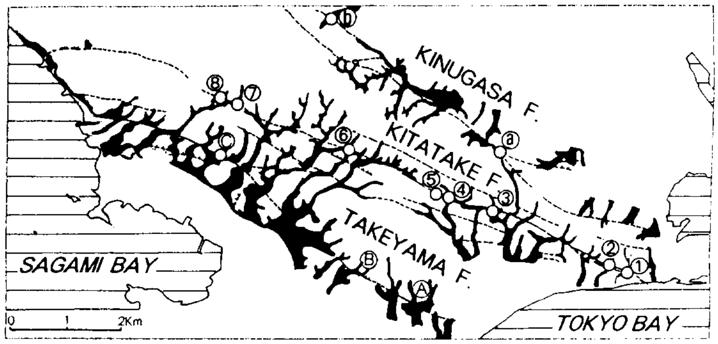

Fig. 2B Right-laterlal offset of valleys crossing Kinugasa, Kitatake and Takeyama faults and location of major trenching and drilling sites. Black areas are offset valley bottom plain (Ota, 1999).

Table1 Summary of timing of the latest activity and repeat time of Kinugasa, Kitatake and Takeyama faults (Ota, 1999)

		Loc.	Method	Faulting Latest event (yr BP)	Faulting Number of faulting	Repeat time (yr)	References
Kinugasa F.	E	a	Trenching	1400–2800	2 times in the last 13000 yrs.	6800–12000	Yokosuka City,1999
	W	b	Trenching	No activity since ca. 1300			Yokosuka City,1999
Kitatake F.	E	①	Trenching	1020–1540			Sato et al.,1997
		②	Boring	1000–1500	3–4 times in the last 8000 yrs.	1000–1500 ~2500	Ota et al.,1991
		③~⑤	Trenching	ca. 1400			Sugimura et al.,1999
		⑥	Trenching	>660			Kanagawa Pref.,1997
		⑦	Trenching	1200–1400			Kanagawa Pref.,1997
	W	⑧	Trenching	>3300			Kanagawa Pref.,1995
Takeyama F.	E	A	Trenching	2000–2200	3 times in the last 5500 yrs.	av. 2000	Ota et al., 1999
		B	Trenching	1600–2600			Ota et al., 1999
	W	C	Trenching	No fault			Ikeda et al.,1993

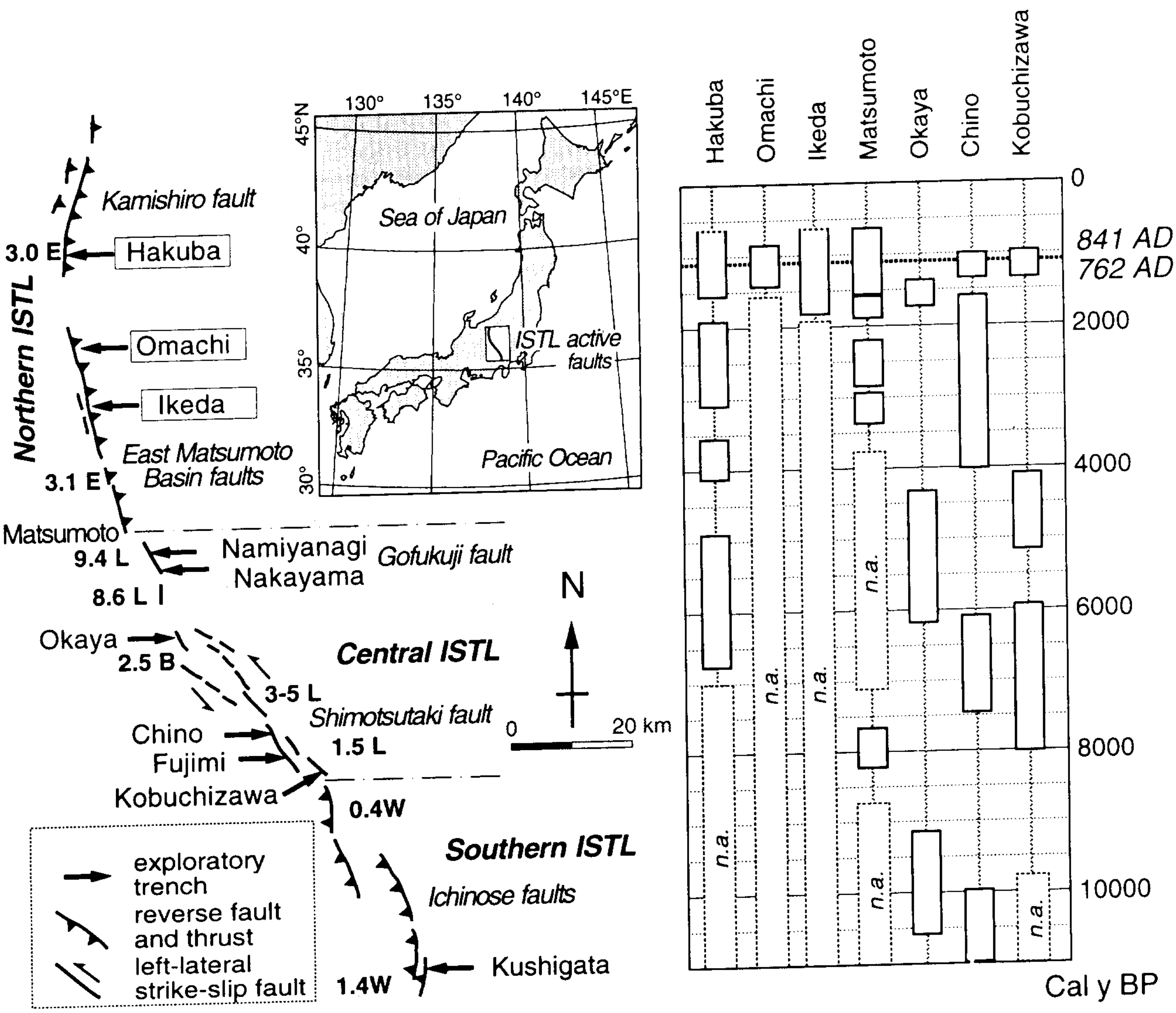

Fig.3 Paleoseismicity of the Itoigawa-Shizuoka Tectonic Line (ISTL) Active Fault System, in Central Japan (Okumura *et al.*, 1998)

Left: Northern and middle part of ISTL active fault system and sites of trenching survey. Numerals indicate average slip rate of the faults in m/1000yrs. E: east-side up, W: west-side up, L: left-lateral, and B: subsidence of Suwa pull-apart basin. Right: Rupture history of the northern and middle portion of the ISTL active fault system. Each rectangular indicates an estimate of the timing of the seismic event.