

The story

In the early winter of 1944 reports came in of ranchers finding shards of paper balloons, rope and metal devices in the fields of Wyoming and Montana. Some of these finds seemed to be related explosions or fires. These first intercontinental weapons, named Fugo after the deadly puffer fish, started to arrive in the western United States and Canada during November 1944 and continued until July of 1945. Finding the launch site(s) of these balloons was one of the great detective stories of WWII and became one of the classic cases of forensic geology. Sand in recovered ballast bags provided the forensic evidence leading to the discovery of the launch sites. Micro-paleontologists and mineralogists in the USGS Military Geology Department (MGU) examined the sand and eliminated various launch sites on the US & Canadian west coasts and Hawaii, concluding that the balloons had been launched from beach areas in Japan.

Creating the incident spreadsheet

Robert Mikesh's 1973 paper in the Smithsonian Annals of Flight series is one of the most comprehensive studies of the balloon bombs, and includes a compilation of incidents compiled from G-2 Periodic Report No. 188, 4 August 1945.

Place	Recovery date	Remarks
3. Thermopolis, Wyoming	6 Dec.	Fragments of a 15-kg Japanese antipersonnel, high-explosive recovered as a result of this incident which occurred at 1800 HWY 6 December. An explosion occurred at this time followed by the lighting of what appeared to be a parachute descending to earth. A bright red flame was also seen by observers of the explosion. Bomb fragments were recovered from the scene of the incident about 15 miles northwest of Thermopolis on 7 December.

Using these listings and Google Earth, coordinates were calculated for the descriptive locations given in the table.



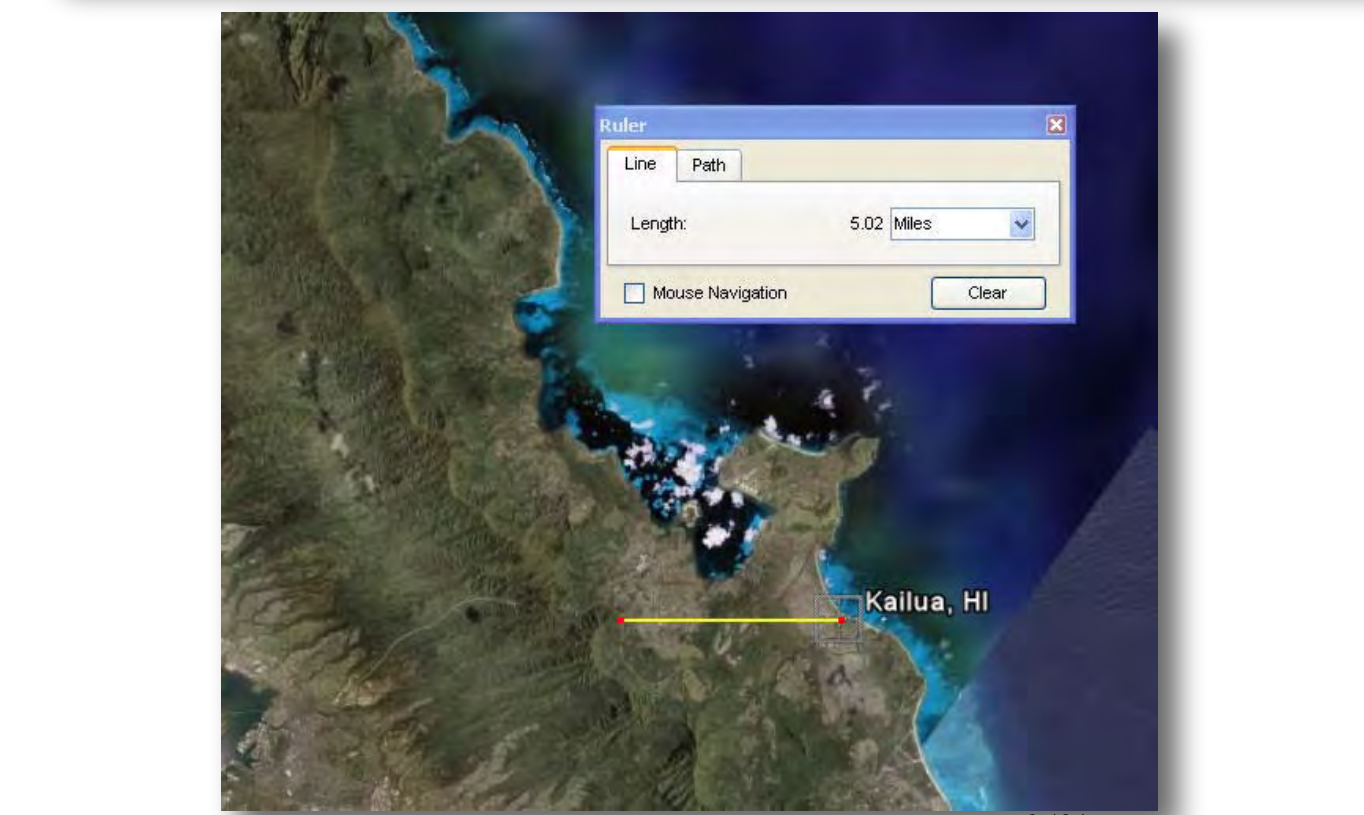
- Excel data of balloon bomb incidents plotted as a simple point shape file on global imagery from ESRI Data & Maps Media kit.
- Addition of cities with populations > 10,000 shows the potential impact of these weapons today.
- GIS software allows for the integration of various data sets and visualization of spreadsheet data for analysis and presentation just not possible in spreadsheet format.

Coordinates and other data were used to construct an Excel spreadsheet of all 285 documented incidents.

Incident No.	Date	Location	State	Remarks
1	12/06/44	Thermopolis, Wyo.	WY	Fragments of a 15-kg Japanese antipersonnel, high-explosive recovered as a result of this incident which occurred at 1800 HWY 6 December. An explosion occurred at this time followed by the lighting of what appeared to be a parachute descending to earth. A bright red flame was also seen by observers of the explosion. Bomb fragments were recovered from the scene of the incident about 15 miles northwest of Thermopolis on 7 December.
2	12/06/44	Thermopolis, Wyo.	WY	Fragments of a 15-kg Japanese antipersonnel, high-explosive recovered as a result of this incident which occurred at 1800 HWY 6 December. An explosion occurred at this time followed by the lighting of what appeared to be a parachute descending to earth. A bright red flame was also seen by observers of the explosion. Bomb fragments were recovered from the scene of the incident about 15 miles northwest of Thermopolis on 7 December.

Some incident descriptions required some interpretation as the descriptions did not fit exactly.

2. Kailua, Hawaii 14 Nov. Paper balloon including envelope, rigging, and some apparatus recovered at sea 5 miles west of Kailua at 1000 HWT by the United States Coast Guard.



5 miles west of Kailua plots on land using Google Earth. This recovery most likely was 5 miles east of Kailua. These plotting errors are inconsequential given the overall scale of the project, but would present an issue with more detailed studies.

"Fugos"-Japan's Balloon Bomb Attacks on North America - a GIS Exercise for Forensic Geology

Dave Tewksbury, Department of Geosciences, Hamilton College, Clinton, NY USA

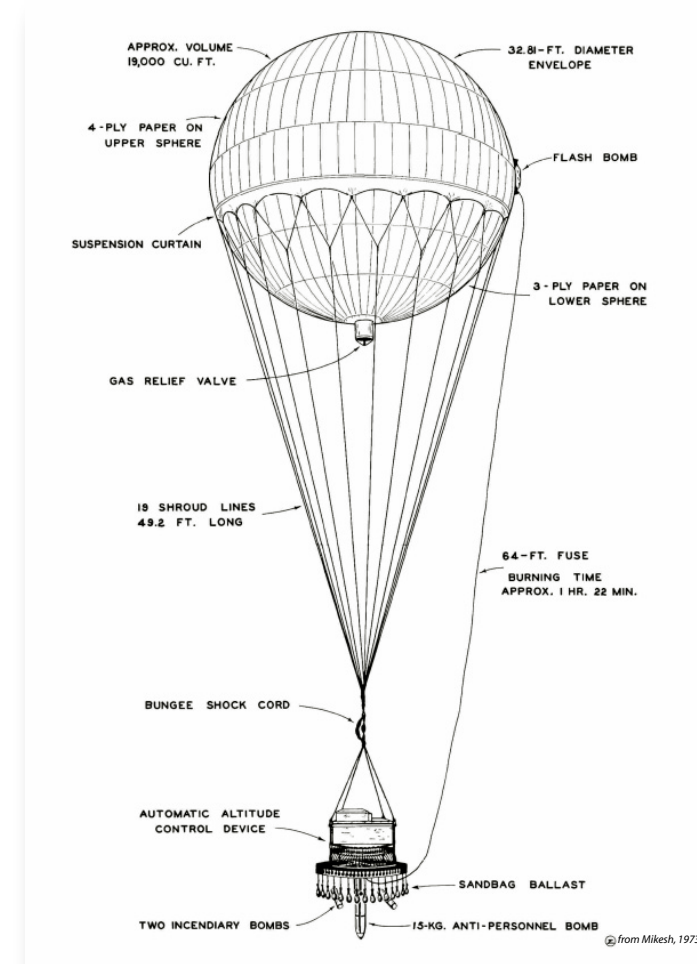


Figure 26. On the left periphery of the release ring is a 2 kg thermite incendiary bomb; sometimes used as ballast in the last release stations prior to the dropping of the main bomb. (U.S. Navy photograph, 80-6-376355, in the National Archives)



Release ring and thermite bomb casing from recovered Japanese balloon bomb

"Poole came in with a couple of little bags of sand. Very much hush-hush... Poole wanted to know where the damn sand came from."

Ken Lohman, head of the USGS Military Geology Unit (MGU) referring to Colonel Sidman Poole (McPhee 1996)

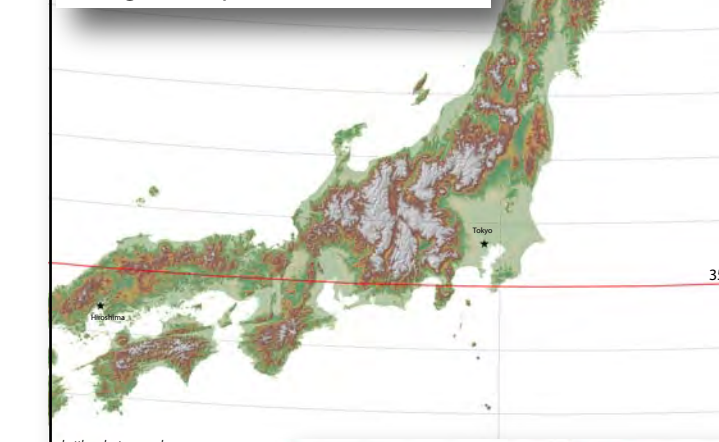
Building the geological story

Sand samples given to the MGU provided some geologic constraints to begin narrowing down the search for the answer to Colonel Poole's question.

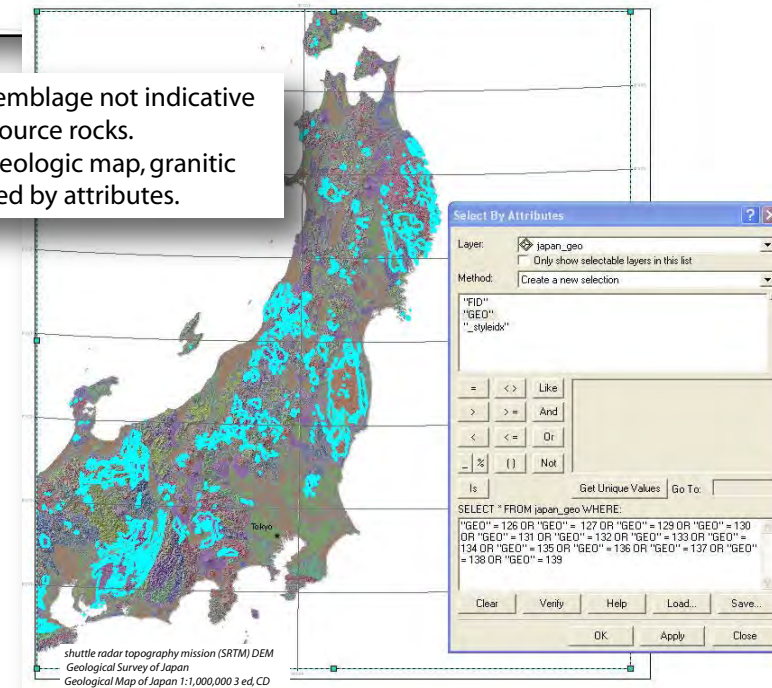
- Micropaleontologist Ken Lohman saw a mixture of fossil and recent diatoms, to Lohman, this said beach sand.
- Julia Gardner, paleontologist, saw no coral.
- Kathryn Lohman, formally a foram specialist for Texaco, found forams.
- Clarence Ross, mineralogist & petrologist found nothing granitic in the mineral assembly.
- Ross did find an unusual assemblage of hypersthene, augite, hornblende, garnet, high titanium magnetite and high temperature quartz.
- All agreed that it was not sand from North America or the mid-Pacific

Using the geologic constraints to map the likely source

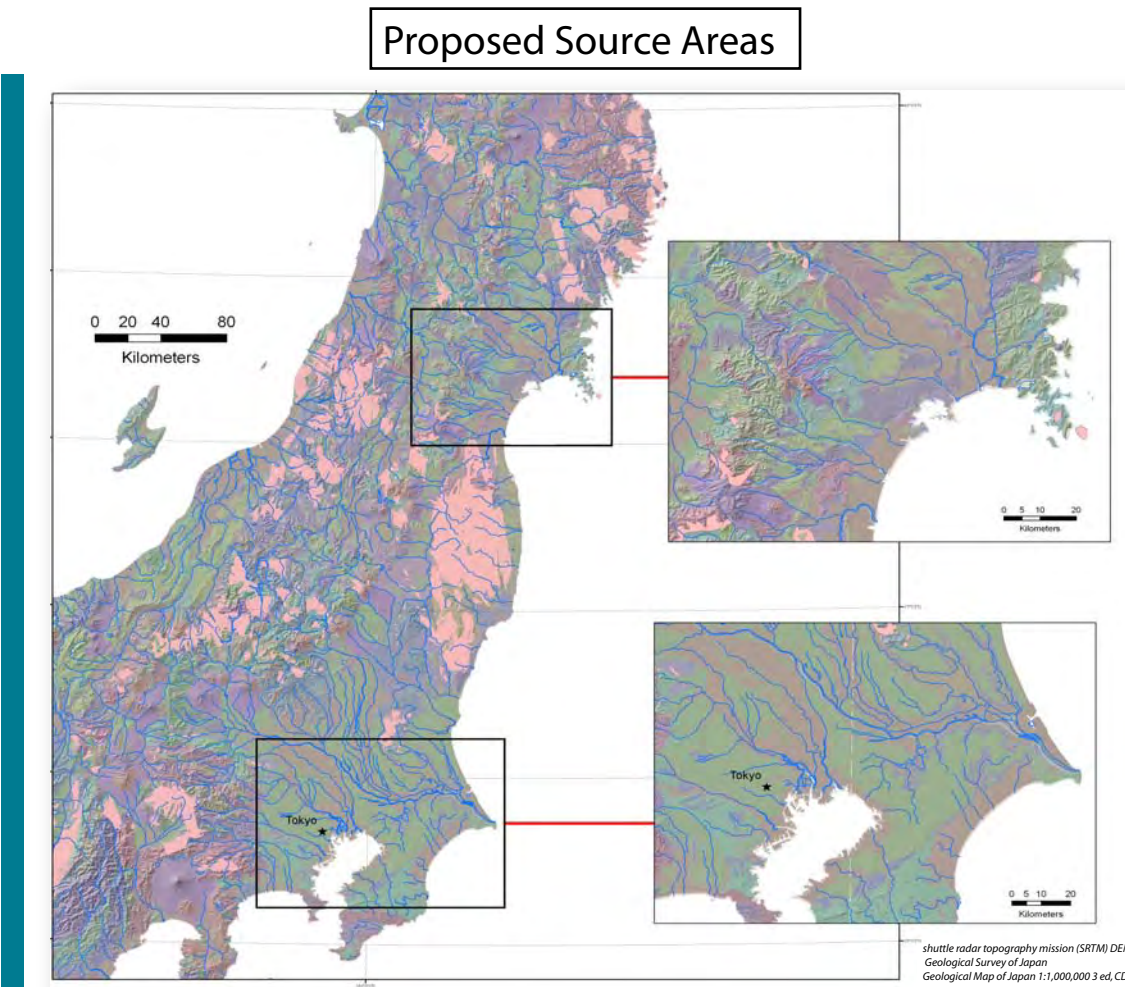
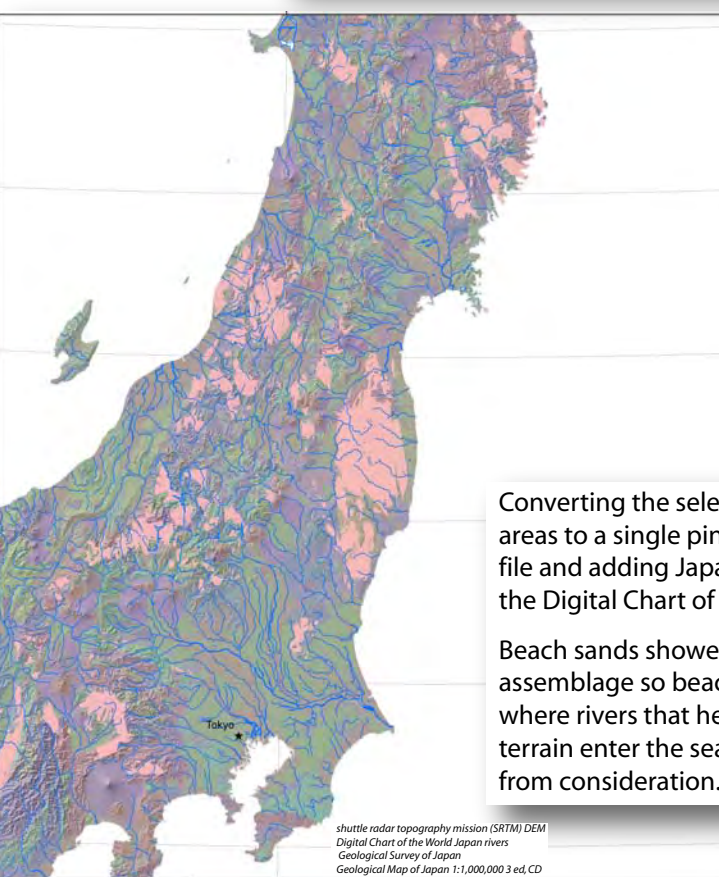
Shaded relief map of Japan showing areas north and south of 35 degrees north latitude. Thirtyfive degrees is the northern limit of coral growth in this area. Lack of coral in the sand samples eliminated beaches south of 35 degrees as possible launch site(s)



Mineral assemblage not indicative of granitic source rocks. On digital geologic map, granitic units selected by attributes.



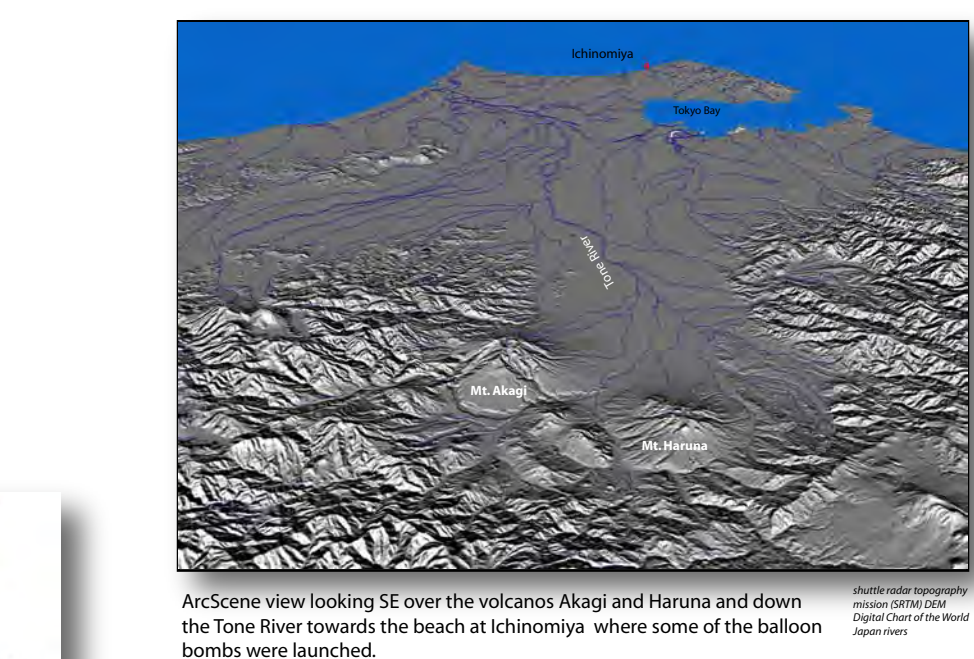
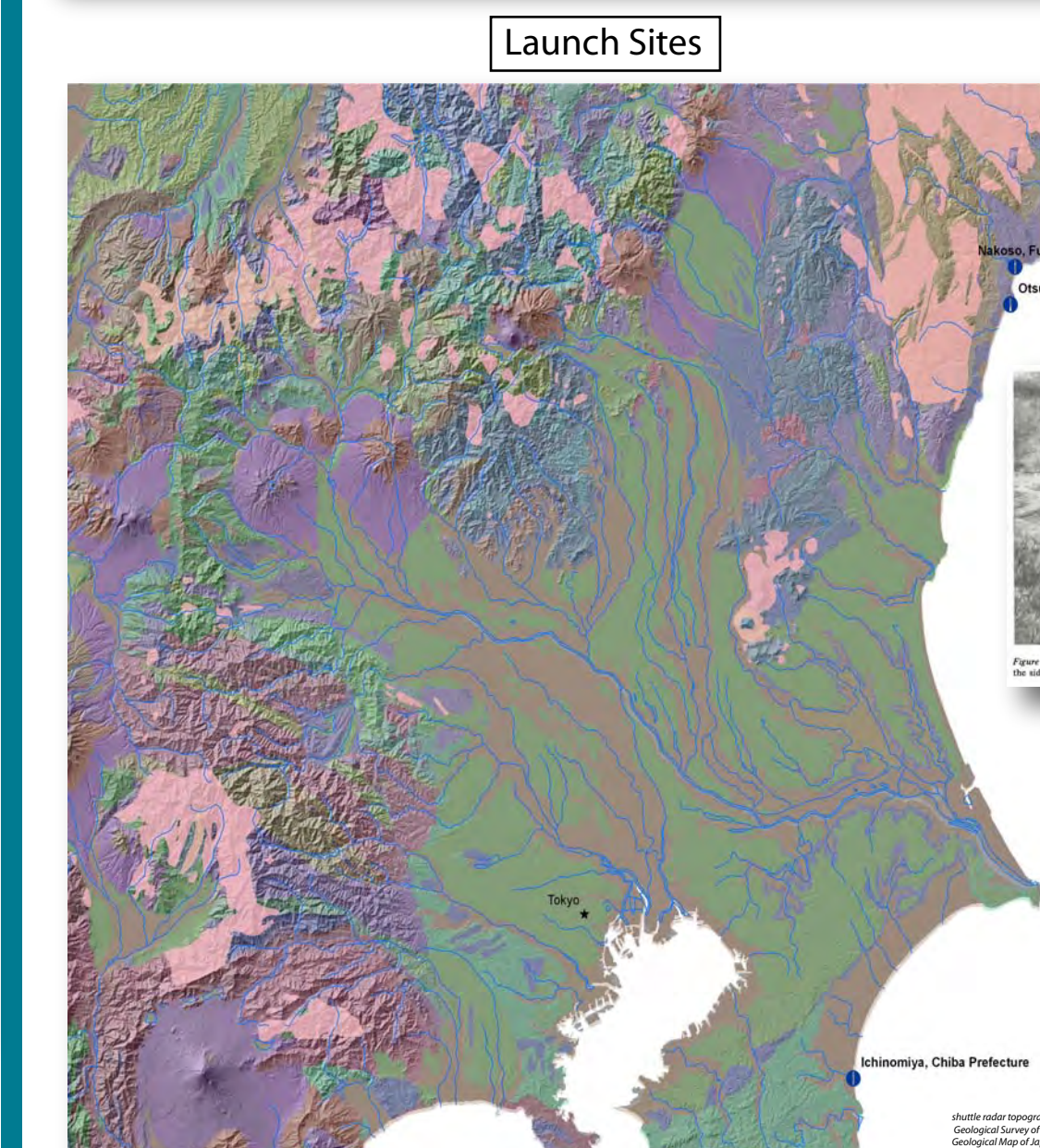
Converting the selected granitic areas to a single pink colored shape file and adding Japanese rivers from the Digital Chart of the World. Beach sands showed no granitic assemblage so beach areas near where rivers that head in granitic terrain enter the sea were eliminated from consideration.



Based on the micropaleontology and mineralogy (volcanic and some metamorphic source rocks) of the sand samples, two areas were determined as likely source areas. A northern area near Ichinomiya and a southern area near Ichinomiya.

The northern area was thought the more likely source as the southern area was close to the 35 degree line and was thought the sand would contain coral fragments.

The mineralogy was a better match to the source rocks in the southern region, but the lack of coral fragments outweighed this.



ArcScene view looking SE over the volcanos Akagi and Hanura and down the Tone River towards the beach at Ichinomiya where some of the balloon bombs were launched.

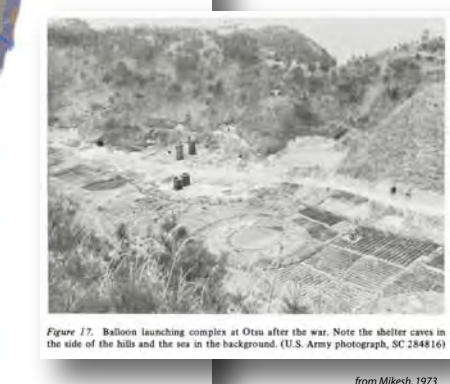


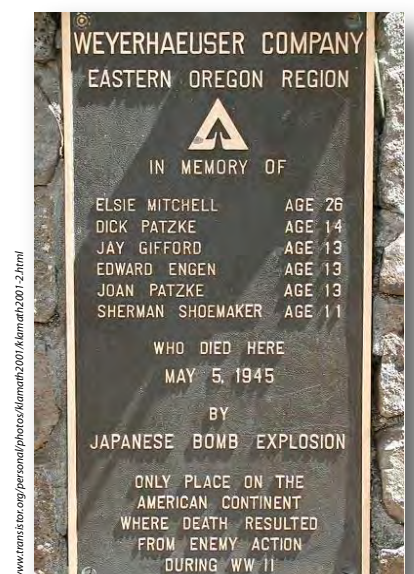
Figure 26. Partially inflated balloon, with its bomb load, in flight over the Pacific Ocean drifting toward the American continent. (U.S. Army photograph, SC 226132)



Figure 26. Partially inflated balloon, with its bomb load, in flight over the Pacific Ocean drifting toward the American continent. (U.S. Army photograph, SC 226132)

The only deaths resulting from these devices occurred on May 5th, 1945 four weeks after the Japanese offensive ended. The Reverend and Mrs. Archie Mitchell of Bly, Oregon along with 5 children were on an outing in the Gearhart Mountain area northeast of Klamath Falls, Oregon.

Mrs. Mitchell and the children found a balloon with unexploded ordnance attached. Due to a news blackout that had been in place shortly after the arrival of the first balloons in November 1944, most civilians were not aware of these weapons and the danger they presented. While pulling the balloon through the woods the 15 kg antipersonnel bomb exploded killing Mrs. Mitchell and all the children. Due to continued censorship, a report of the incident said that an unidentified object had exploded and killed six people. These deaths were the only known fatalities on the United States mainland from enemy action during World War II.

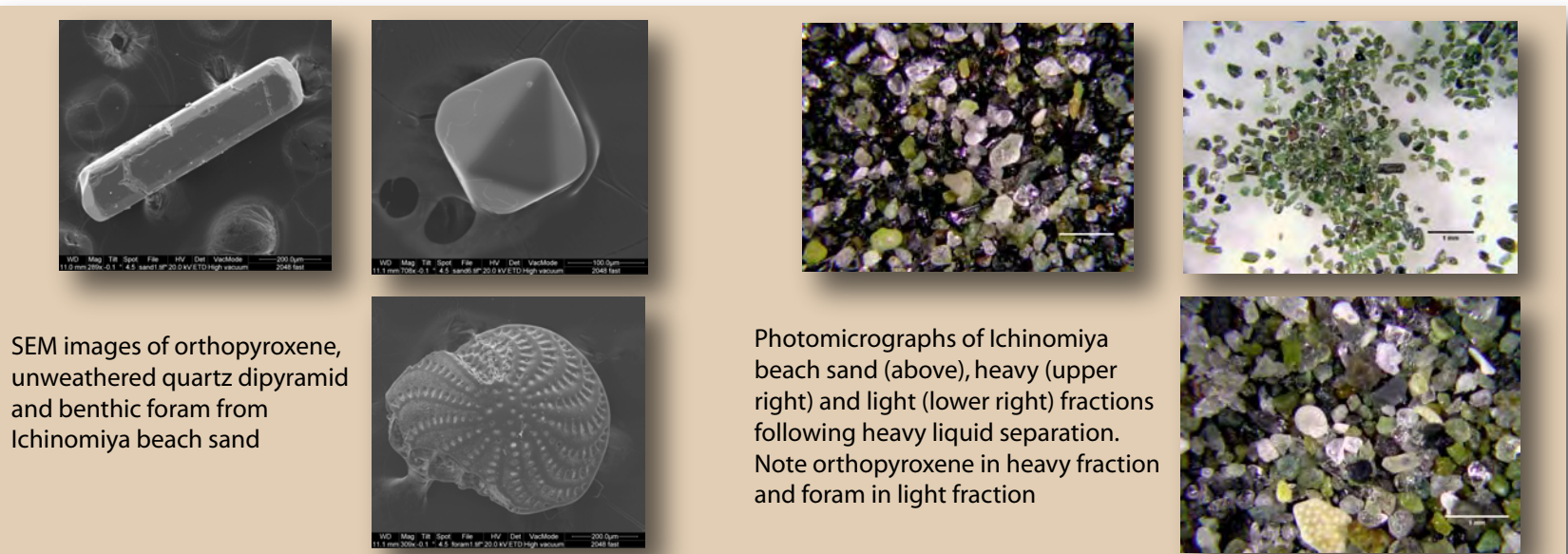


The censorship was so effective that these events are lost in our history.

"On September the 11th, enemies of freedom committed an act of war against our country. Americans have known wars, but for the past 136 years they have been wars on foreign soil, except for one Sunday in 1941."

President George Bush addressing joint session of Congress and the Nation, September 20, 2001

Photomicrographs (Bonus Feature)



SEM images of orthopyroxene, unweathered quartz zirconium and benthic forams from Ichinomiya beach sand

Photomicrographs of Ichinomiya beach sand (above), heavy (upper right) and light (lower right) fractions following heavy liquid separation. Note orthopyroxene in heavy fraction and forams in light fraction

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 Dr. Cynthia Donack for teaching and refreshing my memory of long ago paleontology class.
 Dr. Barbara Tewksbury for insights into rock weathering and transport issues and encouragement as this project grew larger and larger.
 Dr. Timothy Fagan (Honolulu class of 1963) at Wasada University, Tokyo, Japan for the sand samples from 99 League Beach, Ichinomiya.
 McPhee, John 1996. "The Gravel Page". The New Yorker, v. 1, January 29, p. 52-60.
 Mikesh, Robert C., 1973, Japan's World War II Balloon Bomb Attacks on North America, Smithsonian Annals of Flight, number 9.
 www.hamilton.edu/cloudatlas/ca_ballons.html