



Case study: Submarine Crashes into Uncharted Seamount

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Case (for presentation to students)

On January 8, 2005, the nuclear submarine *USS San Francisco* ran aground enroute from Guam to Brisbane, Australia in one of the worst submarine accidents in U.S. naval history. This was a terrible accident made more bizarre by the fact that the submarine crashed into a large seamount (an underwater volcano), rising 2000 m from the surrounding ocean floor. This was definitely a feature that should have appeared on the submarine's navigational charts so that it could have been avoided. Four minutes before the crash the submarine's sonar measured a false depth of 2000 m. The crash actually occurred at a depth of ~160 m, while traveling at a speed of 33 knots or ~38 mph (by comparison the average cruising speed of most oceanographic research vessels is 10-12 knots). The impact of the collision punched huge holes in the forward ballast tanks of the sub (Figure 1), which in turn shut down the throttles, and caused the sub to drift listlessly, its bow pointing down. Luckily, the sub's nuclear reactor and the crew's quarters were not compromised. However, one crewman was killed in the accident and 115 were injured. The rest of the crew managed to keep the sub from sinking during a harrowing 30-hour, 360-mile transit back to Guam.



Fig. 1. Photograph of the *USS San Francisco* in dry dock after the accident (courtesy of David Sandwell, Scripps Institution of Oceanography). Note the men walking within the orange, gated area on top of the submarine for scale.

The commander of the *USS San Francisco* accepted full blame for the incident, acknowledging several critical mistakes, including traveling too fast given the lack of existing data on their navigational chart, not taking enough forward soundings to ensure that their path was really clear, and failing to cross-check the route with other charts. Subsequent interviews with the commander, with fifteen other officers and enlisted men, as well as a review of Navy reports, raises questions about the training and support of U.S. submariners in general, but also the relatively primitive state of nautical charts upon which the crews rely. To wit, Navy officials reported that the main navigational chart in use by the crew, was prepared in 1989 by the Defense Mapping Agency (DMA) and had never been revised. The chart did not show any potential obstacles within three nautical miles of the crash (Figure 2). Soon after the incident, Department of Defense (DoD) officials reported finding a Landsat satellite image from 1999 showing a seamount rising to within 100 feet of the sea surface in the area of the crash (as indicated by subtle variations in water color). Why hadn't the DMA updated their 1989 charts to show this feature? Navy officials said that the incident occurred in an area that was no longer of high priority for updating bathymetry (ocean floor topography) due to the cessation of the Cold War. Although the Navy began basing submarines out of Guam in 2002, it has focused improvement of its nautical charts in the shallow coastal waters of the Middle East as part of the

“war on terror.” The DMA had also consistently lacked the resources to properly compile, convert and interpret satellite data for the systematic updating of charts, nor had it been able to fully ensure the accuracy, precision, resolution, and validity of current charts. This agency has since been absorbed into the DoD’s National Geospatial-Intelligence Agency (NGA), for the provision of maps, nautical charts and other geographic intelligence to the nation’s combat forces.

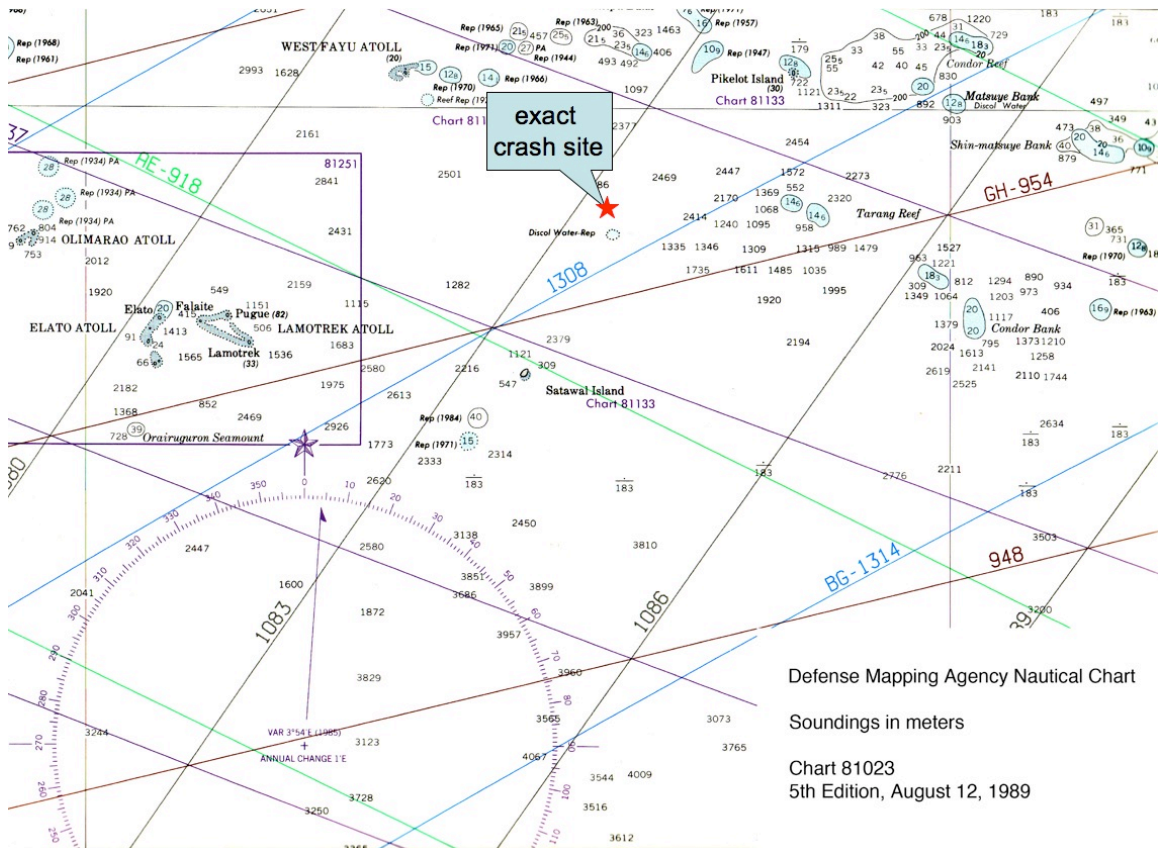


Fig. 2. Defense Mapping Agency (DMA) nautical chart of 1989 with the location marked of the submarine’s collision with the seamount (Sandwell and Wessel, 2006). Note the paucity of soundings in the DMA’s database for this part of the western Pacific.

Mapping of the global ocean floor remains one of the grand challenges of oceanography. Humankind has made more progress during the past 20 years of mapping the surface of our moon, Venus and Mars than during the past 500 years of mapping the oceans. Sandwell et al. (2003) estimates that it will take another 125 years to fully map the ocean floor at a resolution of 200 m, the level of detail needed for most geological studies and deep nautical charts. An even higher resolution is needed for global nearshore ocean resource management, conservation, and spatial planning. In this case study more mapping is a *good* thing, but the cost of this effort is estimated at \$1 billion. The damage to the *USS San Francisco* was estimated at \$1 billion. How many oceanographic mapping expeditions or satellite altimeter missions could have been funded with that lost money?

Partly as a result of the *USS San Francisco* incident, the NGA entered into a memorandum of agreement (MOA) with the Naval Meteorology and Oceanography Command, the National Oceanic and Atmospheric Administration, and the Scripps Institution of Oceanography to improve predicted bathymetry for the world's oceans. This July 2005 MOA includes ongoing efforts to:

- 1) retrack all satellite radar altimetry data for gravity field improvement (funded by NSF, NOAA, and petroleum exploration companies and now mostly complete);
- 2) edit/rescue bathymetry data from about 1800 archived seagoing expeditions (funded by the Office of Naval Research or ONR);
- 3) construct a 1-minute global bathymetry grid for delivery to the parties of the MOA (funded by ONR and recently completed); and
- 4) perform scientific studies with the improved data (ongoing).

Sources

- Drew, C. (2005). Submarine crash shows Navy had gaps in mapping system, *The New York Times*, January 15, 2005. Retrieved 16 June 2008 from www.freerepublic.com/focus/f-news/1321233/posts.
- Drew, C. (2005). For U.S. submarine, a crash, chaos, and then relief: Series of mistakes led to Navy accident, *International Herald Tribune*, May 19, 2005. Retrieved 16 June 2008 from www.ihf.com/articles/2005/05/18/news/boat.php?page=1.
- Hamilton, R.A. (2005). Post script to "Nuclear submarine, *USS San Francisco*, runs into seamount on Saturday the 8th of January 2005," *Ahoy – Mac's Web Log* (Mackenzie J. Gregory and the Naval Historical Society of Australia, Inc.), Retrieved 16 June 2008 from ahoy.tk-jk.net/macblog/NuclearSubmarineUSSSanFra.html.
- Sandwell, D., Gille, S., Orcutt, J.A. and Smith W. (2003). Bathymetry from space is now possible, *Eos, Transactions of the American Geophysical Union*, 84 (5), 37, 44.
- Sandwell, D.T., and Wessel, P. (2006). The global distribution of seamounts from ship depth soundings and satellite altimetry, *Proceedings of the Seamount Biogeosciences Network Workshop*, Scripps Institution of Oceanography, La Jolla, CA. Retrieved 16 June 2008 from earthref.org/events/SBN/2006.
- Staff (2005), Submarine News Daily, February 14, 2005. Retrieved 16 June 2006 from subveteran.org/SSN%20711/050214%20Damaged%20Sub%20To%20Be%20Assessed%20Off%20Island.htm.

Resources for teachers

Suggested discussion points

1. Which of the GISCI Rules of Conduct pertain to this case?
2. How could the *USS San Francisco* disaster have been averted? What lessons can a GIS professional take away from this incident, even if he/she has never served in the military?
3. What is the role of metadata in this case study? What are the implications of poor data quality to navigation of vessels/vehicles at sea or on land?
4. What is the interrelationship between: 1) technical failure; 2) human error; and organizational failure? Which one played the largest role in this case or is too hard to separate them out?
5. What kinds of queries are needed to search a database for a “seamount”? What are the best ways of delivering the data? [Note that there is currently a very interesting ontology issue that oceanographers are wrestling with: “seamount” can also translate to “knoll,” “bump,” “abyssal hill,” “rifted margin,” “active vs. inactive.”]

Relevant GISCI Rule of Conduct

Section I, Number 5: “We shall not knowingly perpetuate bad or outdated data. We shall include all disclaimers (where applicable) about the current condition of the data at the time of creation and/or the original intent of the data.”

Epilogue

Hamilton (2005) reported that a subsequent investigation into the *USS San Francisco* incident found that numerous warnings of shortcomings in the ship’s navigation department existed at least 1 year before the accident and that in a January 2004 inspection, the crew did not properly use its fathometer warning system and its electronic voyage management system. Secret documents later declassified by the Navy revealed further that other charts aboard the sub did in fact clearly display a navigational hazard in the vicinity of the collision. On February 12, 2005 the commander of the *USS San Francisco* was issued a letter of reprimand by the U.S. Navy and permanently relieved of his command, effectively ending his naval career.

Further resources

Text

Wright, D.J. (2002). *Undersea with GIS*, ESRI Press: Redlands, CA.

Reason, James, 1990. *Human Error*. Cambridge University Press, Cambridge. This book describes how multiple factors in so-called “tightly coupled systems” are often involved in incidents such as the *USS San Francisco* accident.

Web

Enduring Resources for Earth Sciences Education (ERESE) (2004). The formation of seamounts. Last accessed 16 June 2008 from <http://earthref.org/cgi-bin/er.cgi?s=erese.cgi?m=8>.

Sandwell, D.T. (2003). Satellite geodesy, global topography, measured and estimated seafloor topography. Last access 16 June 2008 from http://topex.ucsd.edu/marine_topo/mar_topo.html.

Wright, D.J. (2006). Davey Jones' Locker Seafloor Mapping/Marine & Coastal GIS: Treasure chest of web links. Last accessed 16 June 2008 from <http://seafloormapping.net>.

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