

# **Declaration of Participants in the International Conference on the Sumatran Earthquake Challenge**

Padang, West Sumatra, August 28, 2005

For the past three days an international group of earthquake scientists and engineers has met to discuss earthquake hazards in western Sumatra. They reported results from their studies of the recent earthquakes and tsunamis in North Sumatra and Aceh provinces as well as their studies of the earthquake hazards of West Sumatra. Specific recommendations for reducing earthquake and tsunami risks are being sent to governmental and other organizations.

## *Summary of Scientific Knowledge*

It is clear from several investigations that the giant earthquakes of December 2004 and March 2005 were caused by sudden rupture of the Sumatran megathrust fault beneath the islands of Nias and Simeulue and west of mainland Aceh. Rupture of the megathrust caused the islands and surrounding seafloor to jump upward and toward the Indian ocean as much as ten meters. During the earthquakes, the west coast of Aceh and North Sumatra sank one half to one meter. Uplift of the seafloor caused the tsunamis that struck the coasts after the earthquake.

Similar earthquakes struck the Mentawai islands and the coasts of West Sumatra and Bengkulu province in 1797 and 1833. Uplift of the seafloor around the Mentawai islands during those earthquakes caused large tsunamis that struck the mainland coast. Estimates of tsunami heights, from historical reports and scientific calculations, range as high as ten meters. Preliminary calculations suggest that hundreds of thousands of people would be severely affected by a future giant earthquake and tsunami in West Sumatra and Bengkulu provinces.

No one is able to predict scientifically to the nearest day, week or even year when a great West Sumatran earthquake and tsunami will strike next. But the scientific evidence strongly suggests it will occur within the lifetimes of most young people living along the coast today -- such earthquakes occur about every two centuries and the last occurred 172 and 208 years ago. It is very unlikely that any valid prediction will be more specific than this, but we are hopeful that in the long term there will be improvements in forecasting the timing and nature of future large earthquakes. Scientific measurements show that strains now accumulating will culminate in the occurrence of a giant West Sumatran earthquake. During this future great earthquake, the Mentawai islands will behave like Nias and Simeulue did recently -- they will rise suddenly a meter or more. The mainland coast of West Sumatra and Bengkulu province will experience the same sort of sinking as

the west coasts of North Sumatra and Aceh – about one half to one meter. This will lead to substantial permanent coastal changes affecting infrastructure and, hence, peoples' livelihoods.

*What has already been done to prepare?*

Specialists from Japan, Indonesia and the US reported that preparation for eventual earthquake and tsunami disasters can greatly reduce loss of life and property. Among useful activities are the evacuation simulations that have begun in Padang and distribution of educational materials to communities at risk from earthquake shaking and tsunami inundation. Infrastructural changes such as the adoption of better construction practices could ensure that bridges are still usable after severe shaking and tsunami inundation. Efforts to establish a tsunami early-warning system for coastal Indian-ocean communities are also underway through BMG.

Several scientists reported plans for research that will help understand better the nature of the earthquake and tsunami hazard to coastal communities in West Sumatra and Bengkulu provinces. Marine geologic and geophysical studies will lead to a better understanding of the undersea faults that produce big earthquakes. Studies of small earthquakes in the coming months and years will help to pin down that section of the megathrust that is currently locked and that will eventually break to produce big earthquakes. Better topographic maps of the coastal regions and better bathymetric maps of the seafloor will enable more reliable estimates of areas that will be flooded by future tsunamis. Studies of the evidence left by ancient earthquakes and tsunamis will also help in this regard. Such estimates will aid in long-term urban planning aimed at reducing loss of life, property and productivity.

*Recommendations to Indonesian research institutions*

It is imperative that Indonesian governmental agencies support the continuation and expansion of earthquake and tsunami research efforts. Moreover, we support the ongoing efforts of LIPI, BPPT, BMG, BRKP-DKP, ESDM, Bakosurtanal, ITB and other Indonesian universities to attract substantially greater funding from foreign sources to facilitate research on this challenge. Successful research efforts with other nations will help greatly in understanding Sumatra's earthquake and tsunami challenge. We are particularly supportive of collaborations with foreign scientists and governments that include provisions for sustainable improvements in the Indonesian scientific community and infrastructure.

Far more reliable maps of potential tsunami inundation are essential to the people of West Sumatra and Bengkulu provinces. Better bathymetric and topographic maps and a better understanding of likely tsunami sources will be fundamental input to construction of these maps. Indonesian research institutions can play a critical role in accomplishing this goal.

It is essential that the efforts already begun by LIPI to provide educational materials to the citizens of West Sumatra be continued and expanded significantly. These materials have not yet reached many people in coastal West Sumatra and Bengkulu provinces.

And many people who are still fearful of another great tsunami in North Sumatra and Aceh would benefit from better scientific information.

Currently, all eyes are focused on the potential for shaking and tsunami damage from future ruptures of the megathrust. Nonetheless, it is important that Sumatrans not neglect the risks posed by their other great fault, the Sumatran fault, which runs through the mountains, from Semanko Bay to Banda Aceh. For example, Banda Aceh will be more at risk from failure of that fault than from another earthquake and tsunami caused by the megathrust. In this particular case, what ground motions will likely result from rupture of this fault and what is the likelihood of their occurrence? Also, the specific location of the fault must be known so that new construction will not be placed across it.

### *Recommendations to governments and local organizations*

The gradual, systematic reduction of potential loss of life, property and productivity should be a fundamental goal. This requires efforts in three areas: education, emergency response preparation and infrastructural change.

#### **Education**

Education is an extremely important avenue for the reduction of loss of life from tsunamis and earthquakes. For example, we commend ongoing local efforts in Padang and Air Bangis to establish procedures for the rapid and orderly evacuation of people from low-lying coastal regions after a great earthquake. We recommend that earthquake and tsunami education be incorporated into school curricula. These and other types of educational efforts must reach more of the at-risk populations and must be sustained over tens of years.

#### **Emergency response preparedness**

Access to regions affected by future large earthquakes and tsunamis will be critical to saving lives and property and re-establishing normalcy after the next great earthquake and tsunami. To ensure access, important bridges, roads, harbors and airports must be serviceable in the aftermath of the earthquake and tsunami. For example, efforts must be undertaken to ensure that bridges and their approach embankments will survive the earthquake and tsunami. Lessons learned from Aceh will be valuable in this regard. In the case of bridges, the use of shear keys to prevent lateral separation of bridges from their abutments. Roads farther inland are more likely to survive tsunami inundation. The airport authorities should have plans to ensure the viability of their facilities after disasters. For example, equipment should be available to immediately clear tsunami debris from runways. For the most critical harbor facilities, tsunami countermeasures should be implemented.

Emergency response plans should be developed, reviewed and exercised periodically prior to disasters, at all levels of organization. These plans should include such things as the practicalities of initial entrance into a tsunami-inundation zone. The existence of a tsunami early-warning system is intended to serve to inform local governments when it is safe to return to low-lying areas.

#### **Infrastructural changes**

Survival from large tsunamis and earthquakes will require a complex approach. Viability of water-supply pipelines and sewage systems is critical in the aftermath of the earthquake and tsunami. Therefore the vulnerability of water pipes both above- and below-ground needs special attention. For example, water pipes running along bridges should be adequately attached to structural members of the bridge. Also, adequate burial of underground pipes will ensure their survival.

Another activity should be the evaluation of the use of existing tall buildings as vertical evacuation structures. The use of pile-deck structures in hard-to-evacuate districts, as in Japan, should also be considered. Special attention should be paid to the construction of new mosques as vertical evacuation structures.

Floatable structures such as storage tanks and barges may need to have drift-prevention measures.

Establishment of evacuation routes and plans have already begun in Padang and Air Bangis. These efforts should continue to completion.

Precise pre-disaster surveys of property boundaries would help in post-disaster recovery.

Lessons learned from the recent great earthquakes and tsunamis regarding building codes and code enforcement should be implemented throughout the earthquake and tsunami prone regions of Sumatra. Additionally, since many buildings are built without formal compliance to building codes, better dissemination of earthquake- and tsunami-resistant building practices need to be promulgated. Many lessons from the Aceh disaster will be useful here.