Chapter 1

Introduction

Myanmar, also known as Burma, is located at the plate boundary between the Indian and Sunda plates. It is one of the most tectonically active regions in Southeast Asia. During the past several hundred years, numerous earthquakes occurred within this region, resulting from the on-going oblique convergence and extrusion processes between the Indian, Eurasian and Sunda plates.

Although Myanmar has experienced many large and destructive earthquakes throughout its long recorded history, the geology of these earthquakes was never studied in detail due to the logistic difficulty in the past several decades. None of the surface ruptures of the large earthquakes were documented in the past century, and the recurrence intervals and the slip behaviors of major active faults are poorly understood throughout the entire region.

As Myanmar gradually opens up in the past several years, the need of a better understanding of its potential seismic sources becomes urgent due to the rapid development in this once isolated country. Thus, we decided to systematically map the active structures of Myanmar and its adjacent regions, and to conduct a series of field studies to understand the active tectonics of some major active structures in this country. The following chapters are results of these investigations.

We used a global digital elevation model and optical satellite imagery, with the assistance of published geodetic, geologic and seismological analyses to produce an updated version of the regional neotectonic map of western Southeast Asia. The distribution of active structures throughout this region clearly shows that they are the products of three distinctive active deformation belts from the interaction of the Indian plate, the Burma plate, and the northern Sunda

plate. Each of these deformation belts can be further separated into several neotectonic domains, in which active structures show distinctive structural behaviors from one domain to another.

In chapter 2 of this thesis, we provide an overview of the active structures in the country of Myanmar and its surrounding region based on remote sensing analysis. This systematic reconnaissance survey of active structures forms the basic framework for understanding the regional seismic potential in the future, as well as the possible sources of major earthquakes in the history. The discussion of plausible fault slip rates that derived from our geomorphic interpretations is also included in this chapter.

With the understanding of regional neotectonic textures of this area, we then focus on the active behavior of major structures, and the relationship of those structures to major earthquake events in the past. Due to the oblique plate convergence between the Indian and the Sunda plates, the dextral Sagaing fault and the northern extension of the Sunda megathrust are the two most active structures throughout this region. In order to further understand their active behaviors, we have focused on these two structures in the second part of this investigation.

In chapter 3, we provide results of field investigations of an ancient fortress that is offset by the Sagaing fault in lower Myanmar. We successfully mapped the geometry of the fortress wall across the Sagaing fault from the field survey, and thus was able to determine the amount of fault slip since the fortress was built. This study provides the first constraint on the fault slip rate of the southern portion of the Sagaing fault, and plausible earthquake scenarios in the past several hundred years.

The fourth chapter of this thesis focuses on the active behavior of the northern Sunda megathrust along the western coast of Myanmar. We analyze coastal uplift patterns during the famous 1762 Arakan earthquake at Ramree and Cheduba Islands. The analysis suggests the 1762 earthquake resulted from rupture of both the megathrust and major splay faults in the accretionary

prism, similar to other splay faulting events in the sediment-rich subduction zones worldwide.

In the final part of this thesis, we focus on the ground deformations associated with a recent earthquake in remote eastern Myanmar. The Mw 6.8 Tarlay earthquake struck the Myanmar-Laos border in March 2011 and was accompanied by ~30-km long surface rupture along the westernmost Nam Ma fault. In the fifth chapter we provide the field investigation results of the surface rupture during this earthquake, with the assistance of the observations from post-earthquake high-resolution satellite imagery. We also present our InSAR analysis of the Tarlay earthquake in the sixth chapter of this thesis. Together these two chapters provide the analyses of the ground deformations and the fault slip behavior from both field-based and remote sensing observations.