

Chapter 7

Summary and Conclusions

Study of subduction zone is very active field of research because it is known as our planet's largest recycling system. The subducting slab deliver raw materials such as oceanic lithosphere along with oceanic sediments and Sea water to the subduction factory, where these raw materials reequilibrate with ambient mantle, triggering melting and incidentally crating continental crust on the overriding plate. In this context, the present study is an attempt to understand the processes which occurring in these zones. Towards this, we selected Andaman Subduction Zone (ASZ) for such a study that is home, being young subduction zone in the globe, which has all the morphological features which has expected in intra oceanic convergent margin recognized as good potential to understand different processes at very initial stages of chemical modifications resulting form mixing with crustal materials derived for the slab. Additional the interesting features which have attracted our attention to scientific investigations towards this zone; 1) it has one of the youngest arc volcanoes of the world called Barren Island. This has not received much attention from the international community except for the volcano watch groups. Most of the research carried out in this island is by Indian geoscientists, primarily of the Geological Survey of India, and is a very few available in the standard peer-reviewed literature, which has kept the visibility of this active volcano quite low internationally. 2) a special type of geological feature which occur in these zone known as 'Mud Volcanoes' bring materials from subducting slab can throw some light on the chemistry of subducting materials and their influence on arc volcanism which are not yet fully understood in spite of various studies on subduction zone related features.

To find answers to these above questions petrological and geochemical approach through the use of major, trace, stable and radiogenic isotopic ratios in fluid and rock samples were taken. With the help of trace element concentrations and isotopic ratios several modelling has been done in present thesis work. The major conclusions of this study are listed below. The answer to the major objectives of thesis and other inferences achieved are summarized below:

1. Mud volcanoes are excellent features which serve as a window to subducting slab and provide to understand the chemical composition of subducting slab. The erupted materials of these volcanoes also help to establish various subduction zone processes which occur at shallow depth. Through our geochemical and isotopic studies on mud volcanoes of Andamans, for the first time, we have able to characterize the chemistry of the subducting sediments at the Andaman subduction zone. The results reveal; it is the products of altered I-MORB and BOB sediments in which major contributions is from altered I-MORB. Apart from these, this work also has revealed many fascinating aspects of subduction zone processes such a dehydration of clays and decomposition of organic matter etc. at various depths in forearc.
2. Comparative studies of trace elements patterns of mud breccia with red clay suggest that one of the sources of mud breccia may be red clay which is transported from Indonesian archipelago.
3. Geochemical and isotopic studies data from Andaman Ophiolites group of rocks mimic that most of their rocks were derived from boninite parental magma. Some of the samples are also related to

Island arc magma which confirms its origin of supra subduction zone environment.

4. Volcanological studies on Barren Island reveal, it is a young and growing, mafic, island arc volcano in the Andaman Sea. Recent eruptions produced aa and blocky aa lava flows of basalt and basaltic andesite, along with tephra. We, for the first time have reported toothpaste lavas, which are very rare in arc volcanoes, on BI. In the absence of absolute chronology, we grouped the volcanics on BI into three categories based on their relative chronology with respect to the caldera forming event in to pre-caldera, post-caldera, modern.
5. Normalized trace elements patterns of BI lavas suggest that it has typical characteristics of arc volcanics, such as negative Nb and Ti and positive K, Ba and Pb spikes with lesser enrichments of Sr.
6. Major and trace elements are excellent tracer to identify the fractional crystallization. The results from trace and major elements reveal that the precaldern lavas of BI controlled by fractional crystallization of olivine and plagioclase en route to the surface while postcaldera and modern lavas show of magma mixing in the magma chamber prior to eruption.
7. Trace elements along with Nd isotopic ratios are very useful to quantify the contributions from the subducting slab in the lavas. Based on variations of fluid mobile elements (Ba, Ce) and particulate proffered trace element (Th) coupled with Nd isotopic ratios we have established the lavas of BI have contribution from fluids as well as sediments from the subducted Indian plate. Most of the precaldern

samples are affected by fluids and modern and postcaldera samples are influenced by sediments suggest during the initial phases of the volcano was least affected by slab. Comparative studies of BI lavas with all the arc lavas from Indonesia suggest that the former lavas appeared to have low contributions from slab derived materials, making them the most primitive amongst all the volcanoes in this arc.

8. The Mixing models which used in present study reveal that the parental magmas for BI lavas have had 10-20 % contributions from slab components (fluid as well as sediments). Our observations also suggest precaldern lavas are more primitive in nature that has higher contribution from oceanic altered crust with compare to sediments whereas the postcaldera and modern lavas have higher contribution from sediments
9. Our preferred model concurs with the idea of a zone of melt formation with degree of partial melting Known as melting model based on partitioning of HREE. This model suggests that magmas for BI lavas are derived from an I-MORB type of source by 5-10 % of partial melting. BI lavas lies close to melting paths with 20 - 40 % of garnet which indicate BI lavas may have derived from garnet lherzolites at depths more then 80 km.

Scope for future work

Recommendations regarding possible future work that could be undertaken in continuation of the present study are:

1. Ophiolites are considered to be important tools for understanding the tectonic and magmatic processes responsible for the formation of oceanic lithosphere. The tectonic setting of Andaman ophiolites is still in

debate so the lithological and chemical signatures (trace couple with isotopic) of Andaman ophiolites and their mantle section can provide further insights into the tectonic setting where the ophiolitic complexes formed.

2. In the absence of absolute age of BI volcano it is difficult to constrain the temporal changes in the BI lavas, so the geochronological attempts (U-Th dating, Ar-Ar dating) should be made to date volcanism on BI.
3. It has been observed that subducted sediments affected the mantle wedge beneath the Barren island volcano. In the connection Li isotopes are known as good tracer because the $\delta^7\text{Li}$ of altered oceanic crust is much higher at a given Li/Y compared to the mantle. The study along with measured Pb isotope systems which have elevated values with compare to mafic crust and mantle, will allow multiple source components to be resolved.
4. In present study, our focus was mainly on Barren Island volcano; there is one more dormant subaerially exposed arc volcano in Andaman Sea known as Narcondam. It is believed that the lavas of this volcano suffered crustal contamination. So, the details study of lavas of this volcano should give clues to understand the affect crustal interference and also its effect of fractional crystallization of the lava flows. This will give to understand chemical evolution of lava in Andaman subduction zone.