New tectonic insights along the Sunda-Banda arcs transition revealed from geomagnetic observations over the Lombok Island

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ABSTRACT

The Lombok Island is part of the Lesser Sunda Islands (LSI) region – Indonesia, situated along the Sunda-Banda Arcs transition. It lies between zones characterized by the highest intensity geomagnetic anomalies of this region, remarkable as one of the eight most important features provided on the 1st edition of World Digital Magnetic Anomaly Map. New geomagnetic surveys over the Lombok Island which have been carried out in 2006 and 2007/2008 are presented. The new results show the general pattern of contiguous negative-positive anomalies, revealing an active magmatic arc related to subduction region. They agree with earlier results obtained by satellite, aeromagnetic, and marine platforms; and provide a much more detailed picture of the strong anomalies on this island. The temporal characteristics of regional anomalies show a decreasing strength of the dipolar structure, which are faster than the regional secular variations as defined by the global model (the 10th generation of IGRF) therefore need further analysis. Simultaneous magnetic anomalies and gravity models suggested an extension of the Flores Thrust zone (reaching north off the Lombok Island), that become a new mature and active subduction in the back arc region, showing a tendency of progressive subduction during 2005–2008. Monitoring this new subduction activities and the accumulated stress over the LSI could contribute to middle term hazard assessment with a special attention to the earthquake occurrence in this region. Continuous geomagnetic field measurements from a geomagnetic observatory which can be established in the southern part of the Lombok Island together with those from a dedicated recording station in the northern part of the island and systematic measurements at several repeat stations can be useful in this regards.

KEY WORDS: Geomagnetic field, Geomagnetic anomaly, Lombok Island, Sunda-Banda arcs, Flores Thrust, Subduction.

INTRODUCTION

The Indonesian region lies at a junction of four tectonic plates, where a nearly perpendicular subduction of the Indo-Australian plates along the Java Trench is well known (Hamilton, 1979). The Sunda and the Banda Arcs were formed due to this active subduction, shown by green and yellow clustered areas, respectively, in **Fig. 1.** The Lombok Island is a part of the Lesser Sunda Islands (LSI) region; a chain of small to medium size islands situated along the transitional region between these two arcs (shown in the red cluster of **Fig. 1**). Being a part of the Eastern-Indonesian region, as indicated by Hinschberger et al. (2005), this region clearly appears as a tectonically very active area where the deformation is widely distributed and rapidly evolving.

There is a long history of geological and tectonic study of the LSI; however, the detailed morphologies are not fully understood so far. Theories of the tectonic evolution of these islands changed extensively during the last decades and further studies are needed to better understand several aspects of the regional tectonics. Here, we investigate the geomagnetic anomaly pattern obtained from ground surveys and particularly focussing on the existence and extension of the Flores Thrust zone in the back arc region of the LSI.

After its existence was introduced by Hamilton (1979), the extension of this thrust zone to the north of the Bali Island was proposed by Silver et al. (1983) and Silver et al. (1986). Later on, a possible existence of two flanking slabs next to the LSI was supported by an independent new seismic tomography study (Fig. 6 of Hafkenscheid et al., 2001). Results of this study show a possible existence of a subducting slab in the north of the Bali Island, which could not be recognized from the previous tomography study (Fig. 3B of Widiyantoro and van der Hilst, 1996). However, the trace of this slab is not as clear as one in the Moluccas region (Fig. 8 of Hafkenscheid et al., 2001). This is probably due to a relatively young age of this subduction as dated about 3 Ma by Silver et al. (1983), while the crust in the Indonesian region is very thin (Hall and Smyth, 2008).

Lying at the collision of three tectonic plates, the LSI comprises one of the most geologically complex and active regions in the world. Despite many earthquake occurrences, the historical seismicity of this region is poorly understood, due to limited available data which go back no further than 1963 (Engdahl et al., 1998; Engdahl et al., 2007). Meanwhile, it is commonly assumed that that the periodicity of giant earthquakes recurrence for a subduction region is some 300 to 500 years (Satake and Atwater, 2007). After about 300 years of moment accumulation, a giant and devastating earthquake in the Sumatra region occurred in December 2004. Looking into the shallow large earthquakes data of Eastern-Indonesia, Triyoso[1] has identified a possibility of a recurrence probability of 100 years over the LSI region; a slightly shorter period than the common ones. Moreover, Soloviev and Ismail-Zadeh (2003) have generated non-linear dynamic numerical models for long term earthquake predictions based on the global movement data of the HS2-NUVEL1 model. They have predicted that for observed seismicity of M > 6 and M > 7, there are two main clusters over the Indonesian regions. One cluster is over the northwest end of the Sumatera Island and the other one is over the LSI region.

Regarding all above arguments, intensive studies which are aimed for looking deeper into this regional tectonics and its current tendencies are needed. Such studies, including geomagnetic investigations (integrated with all other related geophysical data) can be correlated to the earthquake recurrence probability studies for hazard assessment of this region, to fulfil these urgent needs.

METHODS

Geomagnetic lithospheric maps obtained from geomagnetic satellite measurements and surrounding regional data from marine and aeromagnetic surveys indicate that the Lombok Island (pointed out by blue arrow of **Fig. 1**) lies between zones characterized by the highest intensity geomagnetic anomalies of this region, as described in detail by Zubaidah et al. (2009). Mandea and Thébault (2007) noted it as one of the eight most important geological features provided on the 1st edition of World Digital Magnetic Anomaly Map (Korhonen et al., 2007). The MF6 model (Maus et al., 2008) presented as overlying contours in **Fig. 1**, based on data sets from 4 years (2004–2007) of measurements of the CHAMP satellite, reveals that the subduction zone along the Sunda-Banda Arcs mainly coincides with negative anomaly bands.

We have conducted several geomagnetic surveys over the Lombok Island in order to obtain a better understanding of the regional tectonics by improving the quality of our surveys and data processing (Zubaidah et al., 2005; Zubaidah et al. 2009). From November 24th 2007 to April 3rd 2008, the latest ground-based magnetic survey of total field intensity has been conducted at 177 stations, including measurements at 55 old stations which had been previously occupied in 2006. The detailed information of this geomagnetic survey can be found in Zubaidah (2010); here we only summarize some important aspects of the improved survey methodology and data processing.

During the new survey, a standard proton precession magnetometer (GSM-19T v6.0, GEM System) has been used at all stations, replacing the old manually operated one (ENVI PRO Proton Magnetic System, Scintrex). It measures the total magnetic fields ranged 10,000–120,000 nT with a resolution of 0.01 nT and an accuracy of ±1 nT. Using this automatic equipment helps in minimizing local noises generated by operators as well as diminishing the human errors. Nevertheless, the ENVI PRO has been used over three-day measurements (on 10 stations in the northern area), because the GSM-19T failed after operating in excessively rainy conditions. Since no dedicated local base station had been established, the measurements have been obtained every 60 seconds during 30–60 minutes, to compare and reduce the data using one-minute values of nearby observatories.

[1] http://www.hrdp-network.com/pirba/content/e5781/e5795/e5809/e15439/eventReport15468/PSHA_Wahyu2009.pdf

To schedule our geomagnetic surveys on the magnetically quietest time, we have used the forecast data from the weekly reports of the IPS (Ionospheric Prediction Service of the Australian Space Weather Agency).

The same reference observatory as in our previous work (i.e. Kakadu/KDU in Australia) has been used for data reduction, in this case to epoch 2008.08 (January 29th 2008). The 10th generation of IGRF values (IAGA WG V-MOD, 2005; Maus et al., 2005) for the respective epoch have again been used to subtract the core field. Statistical evaluation applied to the new survey results shows that 99% of stations provided good quality data, which is much better than our previous survey in 2006 with only 75 % good data.

Thereafter, we have generated 2D as well as 3D maps of geomagnetic anomalies and developed new integrated magnetic-gravity models. The new models are obtained using the GM-SYS Profile Modeling, which can generate an integrated model by using Talwani's algorithm (Talwani and Heirtzler, 1964). The models used local gravity data (Sukardi, 1979), constrained with the known geological (Mangga et al., 1994) and tectonic settings of this region (Kopp and Flueh, 2007; Silver et al., 1983; McCaffrey and Nabelek, 1984; Hall, 2002; Nugroho et al., 2009) as well as topography (Becker et al., 2009) and earthquake relocated hypocentres data (Engdahl et al., 1998; Engdahl et al., 2007).

Since we have already described how to generate magnetic models in detail previously (Zubaidah et al., 2009), in this paper, we mainly pointed out the results. More details of the new modelling can be found in Zubaidah (2010).

RESULTS

The 3D map of **Fig. 2** depicts three strong dipolar magnetic anomaly structures. The southern dipolar structure is very similar to the dipolar structure inferred from measurements in 2006 (Zubaidah et al., 2009). This is the strongest dipolar structure in the southern part, undoubtedly; however, the other two dipolar structures in the northern part are even stronger. One at the east side shows the most prominent negative anomaly, while the other one at the west side shows the most prominent positive anomaly.

The map also clearly underlines the pattern of repeated contiguous negative-positive anomalies, with the shorter wavelength anomalies over the southern and the longer ones over the northern part, separated by low positive anomaly ripples in the middle. As has been expected, the negative anomaly extends southward, matching with the general geomagnetic anomaly pattern along the Java Trench. The contiguous positive anomaly peaks over the northern end of the island also suit the general geomagnetic anomaly pattern along the Flores Thrust zone.

Modelling and analyzing over the three profiles of strongest apparent dipolar structures could be interpreted as follow:

P1: Induced magnetizations of middle Miocene igneous intrusive rocks, bounded by some late Oligocene/early Miocene volcanic rocks with high remanent magnetizations. A major subsurface normal fault and a secondary one (two dashed red lines of **Fig. 2**) are underlined, and they are possibly reactivated by a strong nearby earthquake.

P2: Induced and remanent magnetizations of several magmatic intrusions accompanied by several Tertiary and Quaternary lava layers, forming a geothermal reservoir at some 800 m depth below the old crater of Mt. Rinjani range (white circled area in **Fig. 2**). Subductions from both sides are revealed from the shifting of the partially melted mantle to the North (supposedly having started during the early period of Pliocene). The modelled eclogite crust and the accompanying serpentinized mantle wedge fully support the hypothesis of reversal subduction extension and reactivation in the back arc region (Flores Thrust zone).

P3: The same structure as P2, but without geothermal reservoir. A longer wavelength of anomaly could reflect a deeper source, such as a structural discontinuity, which possibly lies following the modelled strike (green dashed line of **Fig. 2**).

The temporal characteristics of regional anomalies show a decreasing strength of the dipolar structure, where decreasing of the field intensities is faster than the regional secular variations as defined by the global model (the 10^{th} generation of IGRF). However, some exceptions (increasing of anomalies) have to be noted and further analyzed for several locations. These temporal changes could be explained related to:

i. The evolution of the back arc region, which shows a tendency of progressive subduction during 2005–2008. This could be revealed from the significant changes of anomalies during this time interval, which coincides with the time interval when the Flores Thrust performed a considerable high seismic activity.

ii. Large stress accumulations over the LSI region, which can produce seismo-magnetic effects of several tens of nT. This could be revealed from the decreasing of total geomagnetic field anomaly at the location of the Lombok Island, as expected due to piezomagnetic effects (Stacey, 1964).

iii. A specific electrical characteristic of the crust of the Lombok Island region, which probably lead to the existence of a high conductivity layer (Uyeda et al., 2009). This could be revealed from long distance (about 275 km) transmission of the co-seismic ULF signals at the time of the Sumbawa earthquakes.

iv. A structural discontinuity over the Lombok Island, which can enhance the piezomagnetic fields. This could be revealed from the large decreasing of geomagnetic anomalies, that exceeds the theoretical maximum magnitude of the seismo-magnetic effects. A specific feature of P3 profile, that shows a longer wavelength of anomalies, could be the hint for the existence of such discontinuity.

CONCLUSIONS

Simultaneous magnetic anomalies and gravity models, which are generated and interpreted in detail, provide new insights into the tectonics and geological evolution of the Lombok Island. The geological structure of this island can be divided as two main parts with different consecutive ages: an old part (from late Oligocene to late Miocene) in the South and a younger one (from Pliocene to Holocene) in the North. A new subduction in the back arc region (the Flores Thrust zone) is considered mature and active, showing a tendency of progressive subduction during 2005–2008.

Geothermal potency in the northern part of this island can be mapped in more detail using these geomagnetic regional survey data. The earlier estimates of reservoir depth (Sundhoro et al., 2000; Hadi et al., 2007a; Hadi et al., 2007b) can be confirmed further to a depth of about 800 m. Evaluation of temporal changes of the anomalies gives some possible explanations related to the evolution of the back arc region, large stress accumulations over the LSI region, a specific electrical characteristic of the crust of the Lombok Island region, and a structural discontinuity over this island.
Based on the results, several possible advanced studies involving geomagnetic data and anomaly investigations over the Lombok Island region can be suggested for the future:

i. Monitoring the subduction activity of the back arc region (the Flores Thrust zone) and the accumulated stress over the LSI, that could contribute to middle term hazard assessment with a special attention to the earthquake occurrence in this region. Continuous geomagnetic field measurements from a geomagnetic observatory which can be established in the northern part of the Lombok Island and systematic measurements at several repeat stations would be useful in this regard.

ii. Investigating the specific electrical characteristic (high conductivity) of the crust, that is probably related to some aquifer layers or metal mineralization. It needs other complementary geophysical methods, such as magnetotelluric (MT) or preferably DC resistivity measurements.

iii. Determining the existence of an active structural fault over the Lombok Island, that could be related to long term hazard assessment over the LSI region. This needs an extension of geomagnetic investigations over the neighbouring islands (the Bali Island in the West and the Sumbawa Island in the East; probably also the Sumba and the Flores islands). This seems possible because the regional magnetic lineations might be used to delineate some structural discontinuities, based on the modelling of contrasts in crustal magnetizations.

REFERENCES

Becker JJ, Sandwell DT, Smith WHF, Braud J, Binder B, Depner J, Fabre D, Factor J, Ingalls S, Kim S-H, Ladner R, Marks K, Nelson S, Pharaoh A, Trimmer R, Von Rosenberg J, Wallace G, Weatherall P (2009) Global bathymetry and elevation data at 30 arc seconds resolution: SRTM30_PLUS. *Marine Geodesy*, 32 (4): 355–371, doi: 10.1080/01490410903297766.Bird P (2003) An updated digital model of plate boundaries. *Geochem. Geophys. Geosyst.*, 4 (3), 1027, doi: 10.1029/2001GC000252.

Bird P (2003) An updated digital model of plate boundaries. *Geochem. Geophys. Geosyst.*, 4(3), 1027, doi: 10.1029/2001GC000252.

Engdahl ER, van der Hilst RD, Buland RP (1998) Global teleseismic earthquake relocation with improved travel times and procedures for depth determination. *Bull. Seismol. Soc. Am.*, 88: 722–743.

Engdahl ER, Villasenor A, DeShon HR, Thurber CH (2007) Teleseismic relocation and assessment of seismicity (1918–2005) in the region of the 2004 *M*w 9.0 Sumatra–Andaman and 2005 *M*w 8.6 Nias island great earthquakes. *Bull. Seismol. Soc. Am.*, 97: S43–S61.

Hadi MN, Yushantarti A, Suhanto E, Sundhoro H (2007a) Survei panas bumi terpadu (geologi, geokimia dan geofisika) daerah Sembalun, Kabupaten Lombok Timur – NTB. *Proc.*, Pemaparan hasil kegiatan lapangan dan non lapangan tahun 2007, Pusat Sumber Daya Geologi.

Hadi MN, Yushantarti A, Suhanto E, Sundhoro H (2007b) Penyelidikan geolistrik dan head-on daerah panas bumi Sembalun, Kabupaten Lombok Timur – NTB. *Proc.*, Pemaparan hasil kegiatan lapangan dan non lapangan tahun 2007, Pusat Sumber Daya Geologi.

Hafkenscheid E, Buiter SJH, Wortel MJR, Spakman W, Bijwaard H (2001) Modelling the seismic velocity structure beneath Indonesia: a comparison with tomography. *Tectonophysics*, 333: 35–46, doi: 10.1016/S0040-1951(00)00265-1.

Hall R (2002) Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: Computer-based reconstructions, model and animations. *J. Asian Earth Sci.*, 20: 353–434, doi: 10.1016/S1367-9120(01)00069-4.

Hall R, Smyth HR (2008) Cenozoic arc processes in Indonesia: Identification of the key influences on the stratigraphic record in active volcanic arcs, *in* Draut AE, Clift PD, Scholl DW (eds.), Formation and Applications of the Sedimentary Record in Arc Collision Zones. *Geol. Soc. Am.*, Special Paper, 436: 27–54, doi: 10.1130/2008.2436(03).

Hamilton WB (1979) Tectonic of the Indonesian region, Geological survey professional paper 1078, US government printing office, Washington.

Hinschberger F, Malod JA, Rehault JP, Villeneuve M, Royer JV, Burhanuddin S (2005) Late Cenozoic geodynamic evolution of eastern Indonesia. *Tectonophysics*, 404: 91–118.

IAGA WG V-MOD (2005) The 10th-Generation International Geomagnetic Reference Field. *Geophys. J. Int.*, 161: 561–565.

Kopp H, Flueh ER (2007) Seismic and geoacoustic investigations along the Sunda-Banda Arc transition. FS Sonne Fahrtbericht/Cruise Report SO 190 SINDBAD, Report Nr. 8, IFM-GEOMAR, Leibniz-Institut für Meerewissenschaften an der Universität Kiel.

Korhonen JV, Fairhead JD, Hamoudi M, Hemant K, Lesur V, Mandea M, Maus S, Purucker M, Ravat D, Sazonova T, Thébault E (2007) Magnetic Anomaly Map of the World 1: 50 000 000, 1st Edition, Commission for the Geological Map of the World (CGMW).

Mandea M, Thébault E (2007) The changing faces of the Earth‘s magnetic field, Commission for the Geological Map of the World (CGMW), Paris. ISBN: 978-2-9517181-9-7.

Mangga SA, Atmawinata S, Hermanto B, Amin TC (1994) Geologi lembar Lombok, Nusatenggara, Lembar 1807, Pusat Penelitian dan Pengembangan Geologi, Indonesia.

Maus S, Macmillan S, Chernova T, Choi S, Dater D, Golovkov V, Lesur V, Lowes F, Lühr H, Mai W, McLean S, Olsen N, Rother M, Sabaka T, Thomson A, Zvereva T (2005) The 10th generation international geomagnetic reference field. *Phys. Earth Planet Inter.*, 151: 320–322.

Maus S, Yin F, Lühr H, Manoj C, Rother M, Rauberg J, Michaelis I, Stolle C, Müller RD (2008) Resolution of direction of oceanic magnetic lineations by the sixth-generation lithospheric magnetic field model from CHAMP satellite magnetic measurements. *Geochem. Geophys. Geosyst.*, Technical Brief 9 (7), Q07021, doi: 10.1029/2008GC001949, ISSN: 1525-2027.

McCaffrey R, Nabelek J (1984) The geometry of back arc thrusting along the eastern Sunda Arc, Indonesia: constraints from earthquake and gravity data. *J. Geophys. Res.*, 89 (B7): 6171–6179.

Nugroho H, Harris R, Lestariya AW, Maruf B (2009) Plate boundary reorganization in the active Banda Arc–continent collision: Insights from new GPS measurements. *Tectonophysics*, doi: 10.1016/j.tecto.2009.01.026.

Satake K, Atwater BF (2007) Long-term perspectives on giant earthquakes and tsunamis at subduction zones. *Annu. Rev. Earth Planet. Sci.*, 35: 349–74.

Silver EA, Reed D, McCaffrey R, Joyodiwiryo Y (1983) Backarc thrusting in the Eastern Sunda Arc, Indonesia: A consequence of Arc-Continent collision. *J. Geophys. Res.,* 88: 7429–7448.

Silver EA, Breen NA, Prasetyo H, Hussong DM (1986) Multibeam study of the Flores backarc thrust belt, Indonesia. *J. Geophys. Res.,* 91: 3489–3500.

Soloviev A, Ismail-Zadeh A (2003) Models of dynamics of block-and-fault systems, *in* Keilis-Borok V, Soloviev A (eds) Nonlinear dynamics of the lithosphere and earthquake prediction, Springer-Verlag, Berlin-Heidelberg, pp. 71–139.

Stacey FD (1964) The seismomagnetic effect. *Pageoph.,* 58: 5–22.

Sukardi S (1979) Peta anomali Bouguer lembar Lombok (Bouguer anomaly map of the Lombok Quadrangle). Pusat Penelitian dan Pengembangan Geologi, Indonesia.

Sundhoro H, Nasution A, Simanjuntak J (2000) Sembalun Bumbung geothermal area, Lombok Island, West Nusatenggara, Indonesia: an integrated exploration. *Proc.,* World Geothermal Congress 2000.

Talwani M, Heirtzler JR (1964) Computation of magnetic anomalies caused by two-dimensional bodies of arbitrary shape. *Geol. Sci.,* 9: 464–480 in Parks GA (ed) Computers in the mineral industries, Stanford Univ. Publ.

Widiyantoro S and van der Hilst R (1996) Structure and Evolution of Lithospheric Slab Beneath the Sunda Arc, Indonesia. *Science,* 271 (5255): 1566 – 1570, doi: 10.1126/science.271. 5255.1566.

Zubaidah T, Kanata B, Utama W, Arumdati N (2005) Pengembangan metodologi elektromagnetik dan aplikasinya untuk evaluasi sumber anomali magnetik bumi: Kajian tentang potensi sumber daya alam di Kota Mataram Pulau Lombok Propinsi Nusa Tenggara Barat. *Laporan akhir kegiatan insentif riset matematika dan ilmu pengetahuan alam*, Jurusan Elektro Fakultas Teknik-Universitas Mataram.

Zubaidah T, Korte M, Mandea M, Quesnel Y, Kanata B (2009) Geomagnetic field anomalies over the Lombok Island region: an attempt to understand the local tectonic changes. *Int. J. Earth Sci. (Geol. Rundsch.),* 99 (5): 1123–1132, doi: 10.1007/s00531-009-0450-4.

Zubaidah T (2010) Spatio-temporal characteristics of the geomagnetic field over the Lombok Island, the Lesser Sunda Islands region: New geological, tectonic, and seismo-electromagnetic insights along the Sunda-Banda Arcs transition. Scientific Technical Report of GFZ, STR10/07, ISSN 1610-0956, doi: 10.2312/GFZ.b103-10079.

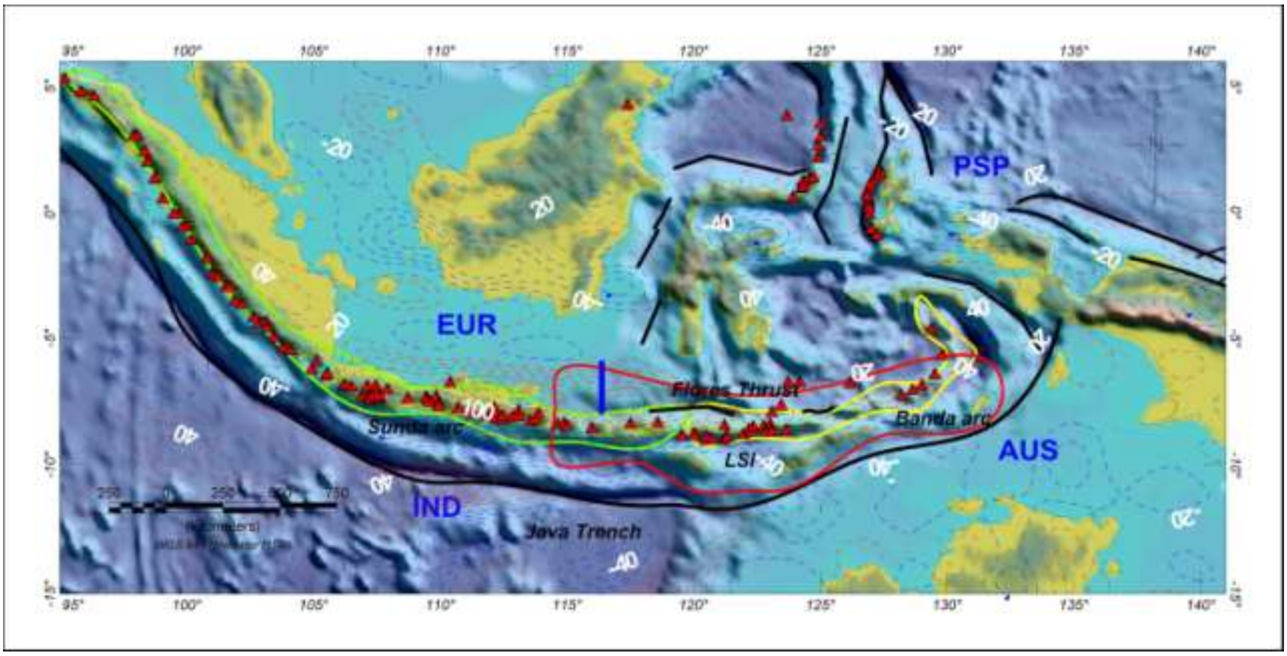

Figure 1
The general tectonic settings of the Indonesian regions, which lie in a junction of the continental Eurasian (EUR)–the oceanic Pacific/Philippine (PSP)–the oceanic Indian (IND)–the continental Australia (AUS) plates (Bird, 2003). The Indian oceanic plate is subducting beneath the Eurasian plate along the Java Trench. The LSI is situated along the transitional regions between the *Sunda-Banda Arcs* (Hall and Smyth, 2008), flanked by the Java Trench and the Flores Thrust (Hamilton, 1979), the morphologies of which are not completely known (Silver et al., 1983; Silver et al., 1986). The Lombok Island (pointed out by a blue arrow) lies between the highest intensity geomagnetic anomalies of this region. The overlying contours are geomagnetic anomalies at geoid altitude from MF-6 model (Maus et al., 2008), with red is positive and blue is negative. The topography and bathymetry are from the SRTM 30 Plus v4 data (Becker et al., 2009), generated using Oasis Montaj (Geosoft software). The volcano data are from the Smithsonian Institution, Global Volcanism Program (http://www.volcano.si.edu).

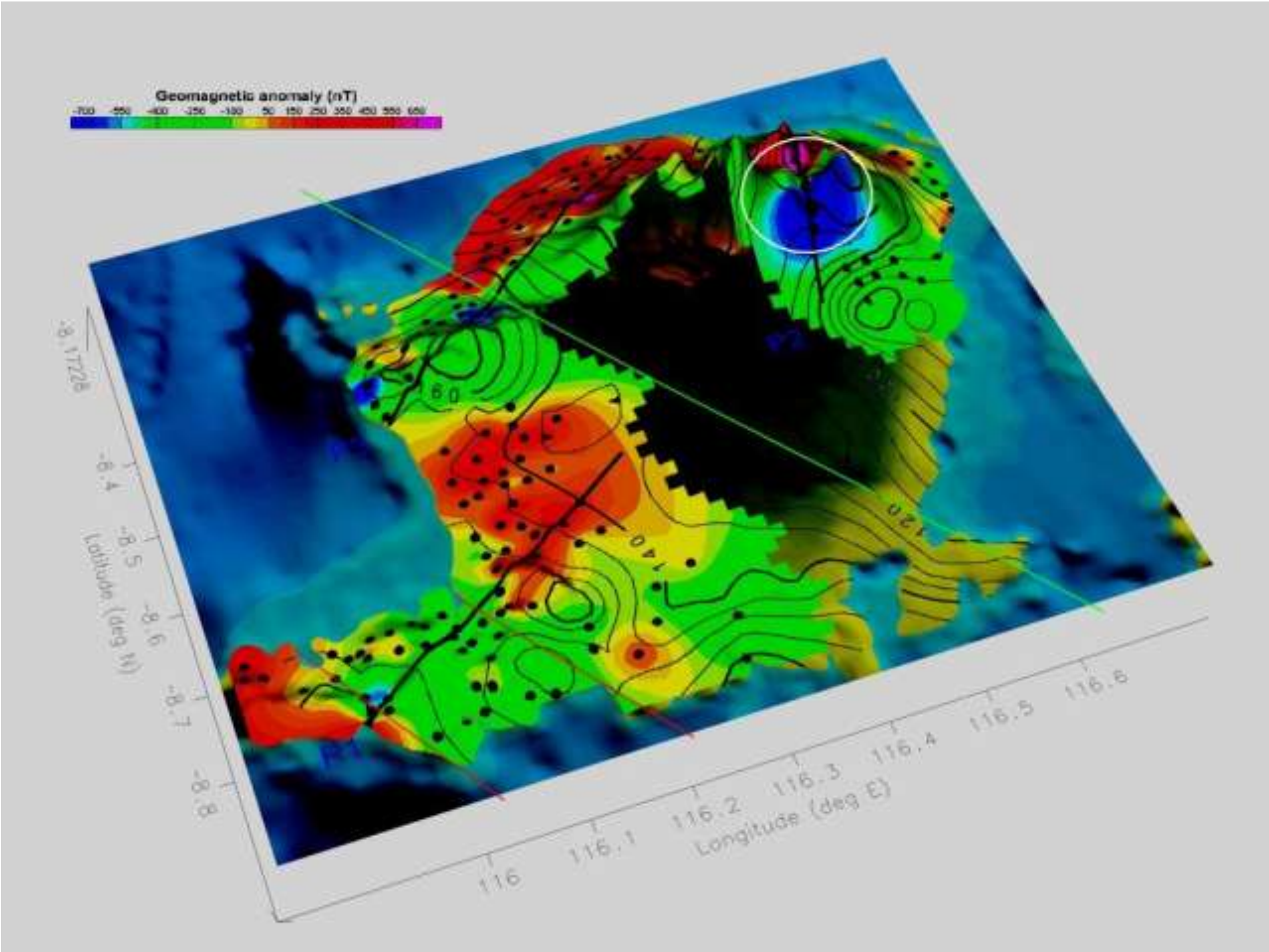

Figure 2
3D view of the total field anomaly map generated from the most reliable data of the 2007/2008 survey (black points are the most reliable stations; total number = 168). The anomaly values are depicted with linear colour intervals of 50 nT, while reliefs are altitudes. The overlying contours are local Bouguer gravity anomaly (Sukardi, 1979) used in the modelling. P1, P2 and P3 are the three profiles of the most prominent dipolar structures, modelled and interpreted in this study. Topography and bathymetry are derived from the SRTM30 Plus v4 data (Becker et al., 2009). This map is generated using Oasis Montaj (Geosoft Software).

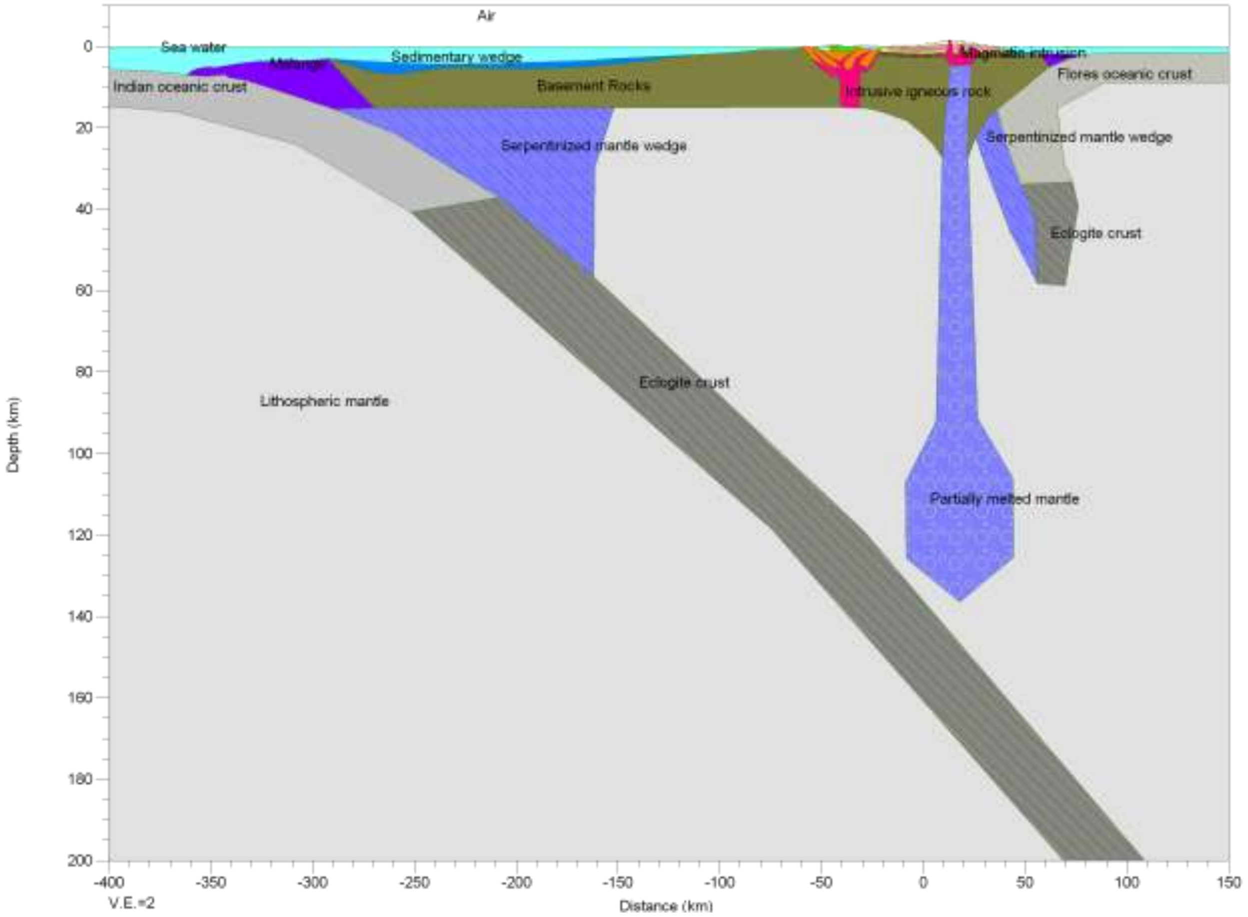

Figure 3
The overall model of the Lombok Island (compilation of P1 and P2 models), representing the present day tectonic settings of this region. The magnetic and gravity anomalies over the southern area are caused by the Indian oceanic crust which is subducting at the Java Trench (315 km south of the main intrusion of P1) and leading to the formation of volcanic rocks as well as intrusions of igneous rock structures. From the opposite direction, the Flores oceanic crust is subducting at the Flores Thrust zone (about 60 km north of the main intrusion of P2). The two simultaneous opposite subductions cause the magnetic and gravity anomalies over the northern area by upwelling of partially melted mantle and forming some lava structures.