Annexure C

AN ILLUSTRATIVE EXAMPLE OF DELINEATION OF SOURCE ZONES IN INTRAPLATE REGION OF PENINSULAR INDIA

This Annexure presents a typical illustrative example on delineation of seismic sources zones (SSZ) for a site in the seismically stable intraplate region of Peninsular India. On the basis of physiography, geotectonic characteristics, major tectonic features, deformation styles, seismicity patterns, and source mechanisms, a total of 6 area type of SSZ denoted by SZ-1 to SZ-6 have been demarcated in the seismotectonic map as shown in Figure C.1.

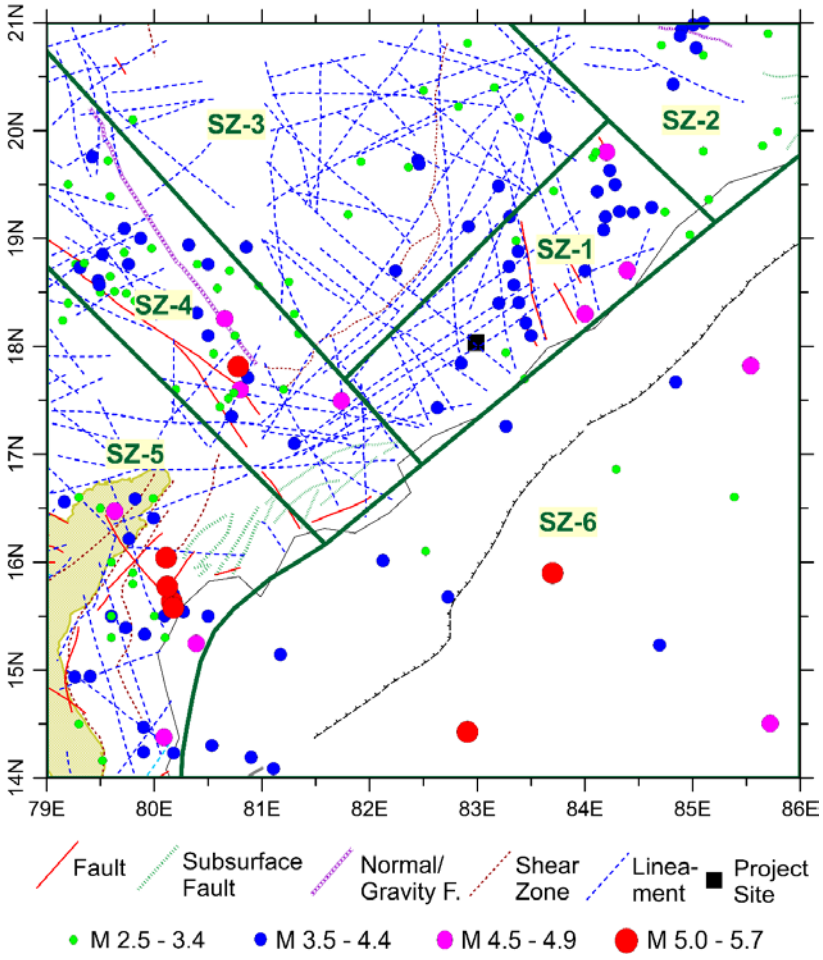

Figure C.1: The six seismic source zones identified in the region of study.

The fault plane solutions (FPS) available for 13 earthquakes in the region of study from the GCMT catalog and other published sources are shown by beach ball symbols in Figure C.2 at the locations of the corresponding earthquakes in the various source zones.

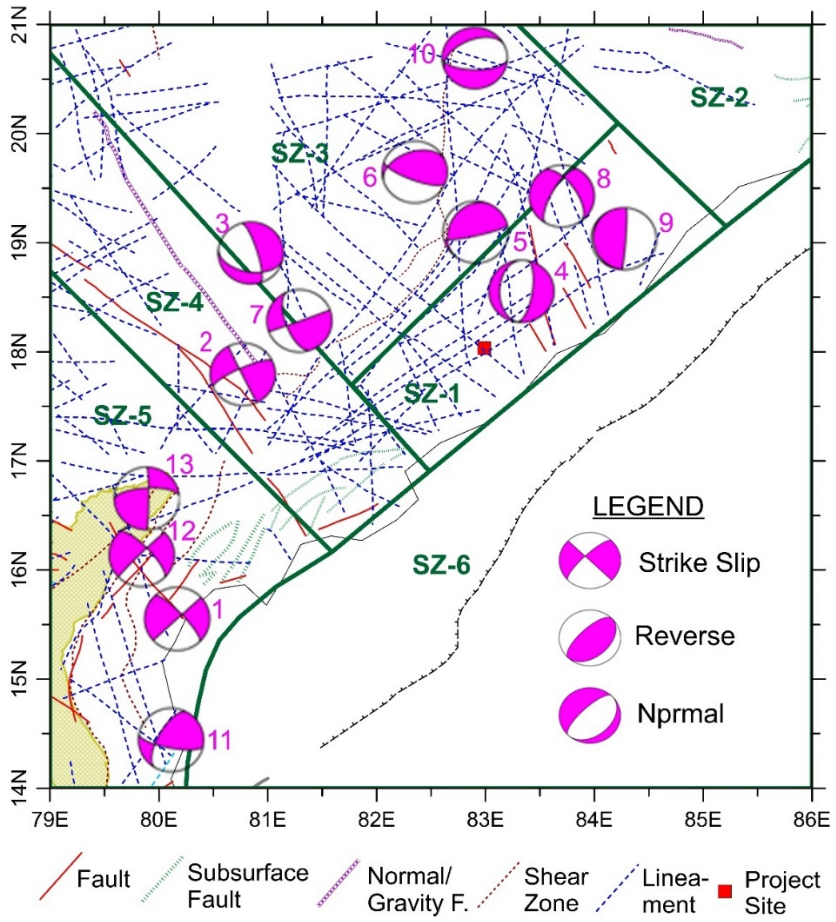

Figure C.2: Seismic Source Zone map with fault plane solutions from CMT and other published sources.

A brief description on each of the source zones, which is designated by a name, is presented as below.

SZ-1: Eastern Ghat Mobile Belt (EGMB) Zone

This source zone with an area of 49,744 km^2 (8.59%) demarcates the area between the east coast and the western boundary of the Bastar craton. The project site is located in this source zone, which has been identified on the basis of its tectonic and geological history, which is characterized mainly by a system of NE–SW and NW–SE trending lineaments. More of the seismicity in this source zone is seen to occur in the northern half, some of which could be associated with a system of NNW–SSE trending local faults of neotectonic nature. The most important among these faults is the Parvatipuram-Bobbilli Fault with a length of about 125 km. A total of only 30 main shocks in the magnitude range of 2.5 – 4.7 are known to have occurred in this source zone during the period 1837 to 2022. This is a low seismicity zone with no earthquake exceeding magnitude 4.5 reported to have occurred after 1858. The three FPS (Nos. 4. 8 & 9) available for this SSZ indicates different type of mechanism as Normal, Normal with significant strike-slip component, and Reverse. The direction of strike for these solutions matches with NNW–SSE trend of a system of local faults with which most of the past seismicity in the zone is associated.

SZ-2: Singhbhum Craton – Mahanadi Coastal Basin

This source zone in the northeast corner of the region with an area of 34,400 km^2 (5.94%) includes a small southernmost part of the Singhbhum Craton and coastal part of the Mahanadi rift basin. No major faults or lineaments is seen to exist in this source zone and a very meagre number of only 12 earthquake events in the magnitude range of 2.9–4.4 are known to have occurred during 1986–2022 in this source zone. This source zone covers only a small western part of the Mahanadi rift basin, which is a composite basin comprising NE–SW trending horst and graben structures bound by gravity faults. No FPS is available for this source zone.

SZ-3: Bastar Craton Zone

This source zone with a large area of 1,12,944 km^2 (19.51%) corresponds mainly to the tectonically stable Bastar Craton with the Chhattisgarh and the Indravati Sedimentary Basins of Precambrian age and the Sileru Shear Zone as the major tectonic features. This zone is characterized by a system of NE–SW as well NW–SE trending lineaments only with no neotectonic faults known to exist. It is marked with only 19 seismic events in a very narrow magnitude range of 2.9–3.8 during most recent 28 years from 1995 to 2022. No earthquake has been reported in this source zone for the earlier period, indicating that no damaging earthquake has taken place in this zone during historical times also. Two of the three FPS available for this SSZ (Nos. 5& 6) indicate thrust type of mechanism and one FPS (No. 10) as normal type of mechanism.

SZ-4: Godavari Rift Basin Zone

This source zone covers the NW-SE trending Godavari rift basin, which occupies an area of 65,712 km^2 (11.35%) in the region of study. This zone is marked with a total of 43 earthquake events of magnitude ranging from 2.9 to 5.7 that occurred during 1968-2022. The M5.7 Bhadrachalam or Kothagudem earthquake of 13 April 1969 in this source zone is the largest known earthquake in the entire region of study. The seismicity of this zone is related to several WNW-ESE trending faults of neotectonic nature. In the lowermost coastal area of this source zone, the Bhimavaram Ridge separates two depressions. The western depression is limited to the west by Bapatla Ridge. Two major neotectonic faults, namely ENE-WSW trending Vasistha-Godavari fault and NW-SE trending Kolleru Lake fault traverse the area.Two of the three FPS in this SSZ (Nos. 2 & 3) indicate right-lateral strike-slip faulting along NW-SE trending subvertical faults, whereas one FPS (No. 7) indicates strike-slip faulting along a conjugate fault.

SZ-5: Eastern Cuddapah Basin and Eastern Ghat Zone

This source zone with an area of of 81,120 km^2 (14.01%) comprises the easternmost part of the Cuddapah sedimentary basin and the Eastern Ghat Mobile Belt. A total of 42 earthquake events in the magnitude range 2.5–5.5 are known to have occurred in this source zone during 1800–2022. The Nallamalai and the Eastern Margin Thrust Fronts or Shear Zones are the two important tectonic features following the shape of the Cuddapah Basin. Several neotectonic faults associated with significant seismic activity during recent times with both NW-SE and NE-SW trends exists in the northeastern part of this source zone. The largest known Ongole earthquake of 27 March 1967 with M_W=5.5 is associated with the Gundlakamma Fault with left-lateral

strike-slip type of mechanism. Two more earthquakes with magnitude 5.0 during 1800 in Ongole-Kanuparti area and magnitude 5.4 during 1959 in Vallempalle-Chinna Ganjam area have also occurred close to this fault, whereas one magnitude 5.3 event has occurred further north in Guntur area. The four FPS available in this SSZ (Nos. 1, 11, 12 & 13) indicate dominantly strike-slip type of mechanism.

SZ-6: Bay of Bengal Offshore Zone

This source zone has the largest area of of 2,35,056 km^2 (40.60%) among all the source zones in the region, which has experienced very low number of only 16 earthquakes in the magnitude range of 3.1–5.4 during 1827–2022. No major faults are known to exist in this offshore zone of intraplate nature. The low level of seismicity within the continental shelf area may perhaps be related to the reactivation of some of the Precambrian faults and minor lineaments on the east coast of India in their offshore extensions, whereas the larger magnitude in the deeper ocean may perhaps be related to the tectonics of the 85° E Ridge. No FPS is available for this source zone.