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Lithological characteristics of the Mafic Rocks of Tadpatri Formation of Pulivendla Taluk, Kadapa District, Andhra -Pradesh, India

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Abstract;

The mafic sills occur at various stratigraphic levels within the shale dominated Tadipatri Formation of the Chitravathi Group, Kadapa Super group of rocks. The Vempalli Formation of the Kadapa Super group of rocks underline the Tadipatri Formation with pulivendula Quartzite Formation lying in between two. Within the Tadipatri formation, the differentiated sills in the lower part, doleritic sills at different stratigraphic horizons and basaltic sills are emplaced in the upper part. The differentiated thick mafic sills of the tadipatri Formation are characterized by a lower thin chilled margin followed upwards by olivine gabbro and leucogabbro. The Tadipatri Formation conformably overlies the Pulivendula Formation with a gradational zone .This unit is characterized by more than 4 km thick sequence of shale with minor intercalated siltstone ,sandstone and stromatolytic dolomite .In addition ,there are different varieties of mafic sills and acid tuffs . They are very well exposed around Pulivendla, north east of Velpula, in between Chinna Ramgapuram and Pedda Rangapuram, north east of Ternampalle and in hill sections to the north and south of Eramareddipalle. The sills are characterized by chilled, fine grained margin followed by coarse grained olivine gabbro in the lower part and leucogabbro in the upper part. The olivine gabbro is melanocratic and highly pock marked on weathered surface due to differential weathering of olivine (The contact between the melanocratic olivine gabbro in lower and the leucogabbro forming the upper parts of the sills is sharp. The upper leucogabbro parts of these sills are columnar jointed and are quarried at places for construction materials.

KEYWORDS: kadapa basin, Tadipatri Formation, , Litholgy

Introduction:

The mid – Proterozoic crescent shaped Cuddapah basin located in the eastern peripheral parts of the
Eastern Dhawar craton covers an area of 44,500 sq. km and exposes a thick pile of volcano –sedimentary sequence. The basin with its convexity towards west extends for a length more than 400 km along north – south direction while its maximum width is about 145 km across its middle part. The cumulative thickness of the total pile of sediments in the basin is about 12 km. The igneous activities are manifested across the whole stratigraphic succession of the basin in the form of sills, basaltic flows, dykes, and minor plutons. A large number of sills of varying dimensions are reported across the whole extent of the shale dominated Tadpatri Formation of the Cuddapah Super group of rocks. The area of investigation falling under Cuddapah district of Andhra Pradesh is in the southwestern part of the Cuddapah basin and covered by parts of the Survey of India toposheet nos. 57J/2, 3, 6 and 7. The objective of the item was to carry out petrological and ore miner graphic studies of the mafic rocks with an aim to test their PGE potential. In year 1872, William King, in his memoir on Cuddapah, wrote “Near the base of the fines hales is a band of sub crystalline limestone beds with which are intercalated thin layers of felt stone orpetrosilex over which comes two thick flows of greenstone. When crystalloid, the rock is then seen to contain apparently worn crystals of chlorite, feldspar and carbonate of lime. The crystals are however, more generally sharp in their outline.” From field evidence (lack of intrusive character), petro graphic study and chemical data, William King concluded that these rocks represent feldspathic lava and that there are numerous such bands present within the Tadpatri shale. Acid volcanics have also been previously reported from the Tadpatri Formation by Sen and Narasimha Rao (1967) and Nagaraja Rao et al (1987). In course of the present work, a few acid volcanic bodies occurring within the Tadpatri Formation have been located and studied. In the lower part of the Tadpatri Formation, a dark grey colored, extremely fine grained concordant body with exposed thickness of more than 2 m is exposed at Pulivendla at the western extremity of the Loyola College hill. This body is immediately overlain by the differentiated olivine gabbro sill. A few kilometers to the north west of Pulivendla in hill section to the north east of Ternampalle, the differentiated olivine gabbro sill is underlain by two thin concordant bodies of dark grey coloured, very fine grained, hard, compact igneous rocks.

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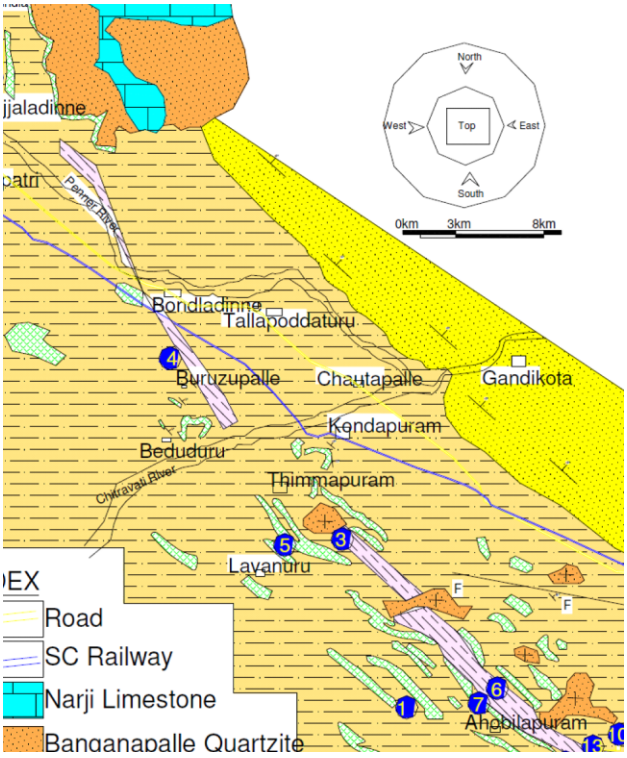
These two bodies are probably igneous flows because of the presence of a number of vug like structures.

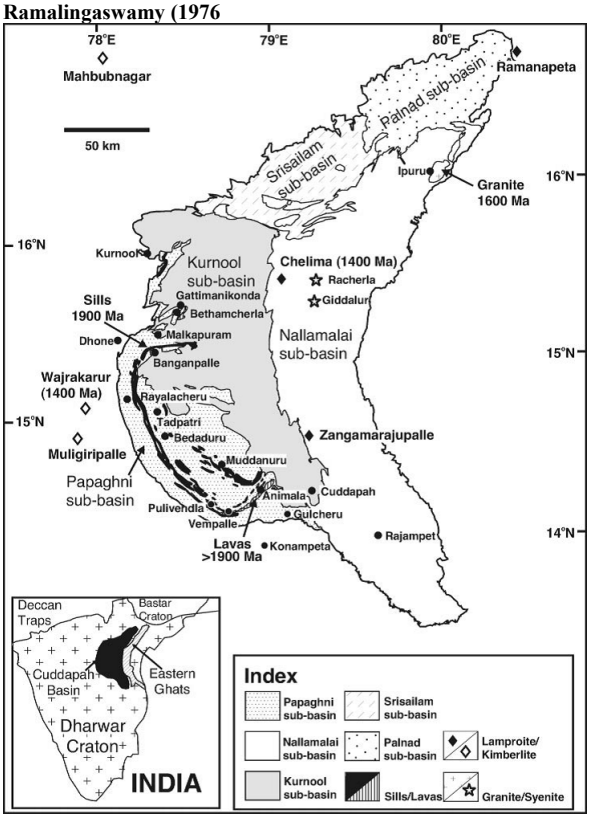
STUDY AERA :

The area of study area is covered by Survey of India toposheet numbers 57J/2, 3, and is bounded by latitudes 14°15‟00” to 14°45‟00” and longitudes 78°00‟00” to 78°30‟00”. The most important locality within the area is Pulivendla (14.4167°N, 78.2333°E. Distance of Pulivendla from Hyderabad is around 432 kilometers and can be approached from Hyderabad via NH-7 up to Kurnool or Anantapur from where southeastward/eastward roads lead to Pulivendla town. Distance of Pulivendla from district headquarter Cuddapah is ~ 64 kilometers and it is 74 km, 158 km and 35 km respectively from the towns of Anantapur, Kurnool and Kadiri from each of which it may be approached via all weather metal roads. Another important locality within the study area is Vempalle which is around 26
kilometers south of Pulivendla.



GEOLOGICAL SETTING:

Geological map of the Cuddapah Basin, after Nagaraja Rao & Ramalingaswamy (1976



General geology:

Kadapa basin, one of the largest Proterozoic basins in India, consists of sedimentary and associated volcanic rocks of about 12 km thickness, ranging in age from late Paleoproterozoic to Neoproterozoic (Nagaraja Rao et al. 1987; Bhaskar Rao et al. 1995; A detail description of stratigraphy,igneous activities, mineral potentiality and basin evolution is summarised by Nagaraja Rao et al. (1987). Tadpatri Formation hosts argillaceous sediments with thin intercalated quartzite and volcanogenic sediments overlying the Pulivendula Quartzite in the Chitravati Group. NagarajaRao et al. (1987) have given a detailed description of stratigraphic of the Tadpatri Formation which consists of shale with quartzite intercalations, shale with limestone/dolomite intercalations, shale with ash fall/flow and tuffs, shale with stromatolitic dolomite intercalations from bottom to top. The basic flows and sills are also present along with acid volcanics in the Tadpatri Formation. The tuffs are mainly acidic in composition. The area
from Tadpatri to Tonduru is a NW-SE .where the litho units are striking NW-SE and dipping around 100 towards NE and basic flows are very common along the same trend.

Tadipatri formation:

The Tadpatri Formation conformably overlies the Pulivendla Formation with a gradational zone in between (Lakshminarayana et al, 2001). This unit is characterized by more than 4 km thick sequence of shale with minor intercalated siltstone, sandstone and stromatolytic dolomite. In addition, there are different varieties of mafic sills, rhyolite and acid tuffslarge number of sills, varying in thickness from about a metre to 50 metres, intruding the argillaceous pile of rocks have been sampled. The mafic sills within the Tadpatri Formation occur at various stratigraphic levels .The thicker sills form NW-SE trending ridges with steep slope towards south and very gentle slope towards north. From south to north intervening areas in between the successive ridges are characterised by low grounds which are chiefly occupied by shale. The differentiated sills in the lower part of the Tadpatri Formation, the doleritic sills at different stratigraphic horizons and basaltic sills in the upper part of the formation have been identified by Based on mineralogy and texture, the present work identifiy at least one different type of gabbro/dolerite sills within the Tadpatri Formation:

1.The thick differentiated gabbro sills (olivine gabbro to leucogabbro) occur in the lower part ofthe Formation. The olivine gabbro sills are emplaced at least at two different stratigraphic levels. These sills are about 50 metres in thickness with shallow (10-15°) northwesterly to northerly dip. The sills were sampled from west of Vemula in the east to south of Bidinamcherla. They are very well exposed around Pulivendla, north east of Velpula, in between Chinna Ramgapuram and Pedda Rangapuram, north east of Ternampalle and in hill sections to the north and south of Eramareddipalle. The sills are characterized by chilled, fine grained margin followed by coarse grained olivine gabbro in the lower part and leucogabbro in the upper part. The olivine gabbro is melanocratic and highly pock marked on weathered surface due to differential weathering of olivine (Fig. 1).

Other Igneous Rocks in Tadpatri Formation

In year 1872, William King, in his memoir on Cuddapah, wrote “Near the base of the fine shales is a band of sub crystalline limestone beds with which are intercalated thin layers of felt stone or petro silex over which comes two thick flows of greenstone. When crystalloid, the rock is then seen to contain apparently worn crystals of chlorite, feldspar and carbonate of lime. The crystals are however, more generally sharp in their outline.” From field evidence (lack of intrusive character), petrographic study and chemical data, William King concluded that these rocks represent feldspathic lava and that there are numerous such bands present within the Tadpatri shale. Acid volcanics have also been previously reported from the Tadpatri Formation by Sen and Narasimha Rao (1967) and Nagaraja Raoet al (1987). In course of the present work, a few acid volcanic bodies occurring within the Tadpatri Formation have been located and studied . In the lower part of the Tadpatri Formation, a dark grey colored, extremely fine grained concordant body with exposed thickness of more than 2 m is exposed at Pulivendla at the western extremity of the Loyola College hill. This body is immediately overlain by the differentiated olivine gabbro sill. A few kilometres to the north west of Pulivendla in hill section to the north east of Ternampalle, the differentiated olivine gabbro sill is underlain by two thin concordant bodies of dark grey coloured, very fine grained, hard, compact igneous rocks. These two bodies are probably igneous flows because of the presence of a number of vug like structures. There is a one meter thick shale horizon in between these two flows. The lower flow is dark grey in colour and extremely fine grained. At its contact with the underlying shale, a large number of minute spherical structures filled up by feldspar aggregates, are uniformly distributed across the fabric of the rock. The upper part of this sill is characterized by spherical structures, up to 4 cm in diameter, filled up by secondary minerals. The upper flow is also dark grey in colour and extremely fine grained and charged with unevenly distributed minute structures which are circular to sub-circular and locally squarish in outline and filled up by feldspar ± chlorite. The distribution of these structures has given rise to a crude layering in the flow. These structures are up to 2 mm in diameter and at places a number of such structures are fused together. The thickness of the upper flow is in excess of 2 meters. In areas 2 km NNE of Lavanuru spotted dip chocolate brown and grey shales are interbanded with 30 cm to 1 m thick bands of pinkish red to pink siltstone are exposed. These siltstones also show dark coloured spherulitic bodies and often the siltstone contains pseudomorphs of pyrite crystals. A number of dolerite / gabbro sills have intruded this shale-siltstone sequence.Rhyolitic concordant sills / flow were also noted from areas 0.5 km from SSE of Kommaddi.Two such bodies, each having a thickness of ~ 1.5 m are separated by one 30 cm thick shale band.The rhyolite is very fine grained, hard, compact and greyish pink in colour.Southeast of the village Santakovuru one 60 m long leucocratic, coarse grained keratophyredyke trending N70º E– 70º W with a maximum width of 15 m cuts across a dolerite sill of the Tadpatri Formation

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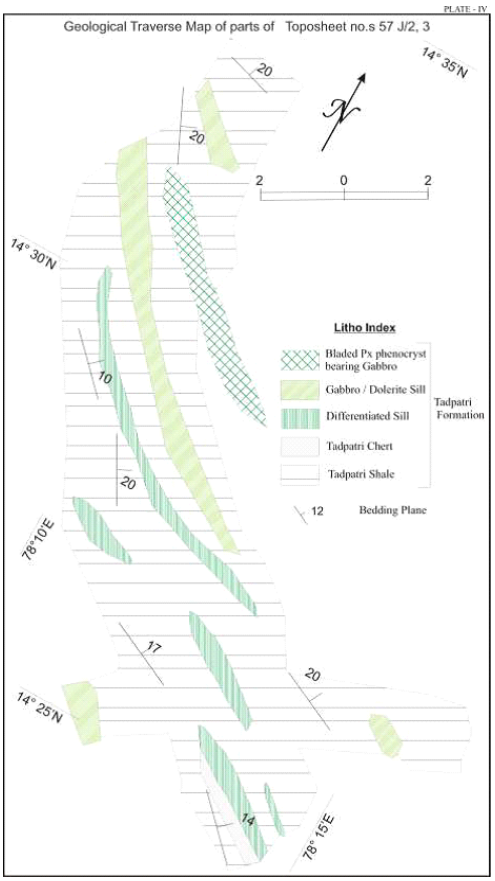
Figure-1
Pock marked surface of melanocratic coarse grained olivine gabbro created through differential weathering of olivine compared to other silicates(Southern slope of the Loyola college hill)



TADIPATRI FORMATION LITHO INDEX :

GandikotaQuartzite----------
TadpatriFormation----------Shale
Shale with stromatolitic
Volcaniclastics
Volcanic ash fall deposit
4600m thick Volcanic
flow deposit
Volcanic Surge deposit
Shale with tuff
Shale
Shale with stromatolitic
Shale
Pulivendula Quartzite ----------

Sample Number	Latitude	Longitude	LITHOLOGY
SV1	14°26' 39.6"	78°12'42"	Dolerite-Up part of sill
SV2	14°25' 08.2"	78°13'56.1"	Felsic Gabbro - Up part of sill
SV3	14°25' 05"	78°13'47"	Gabbro sill
SV4	14°26' 48.8"	78°11'44.9"	Cherty shale
SV5	14°34' 28.4"	78°04'28.4"	Olive green chert
SV6	14°36' 55.5"	78°11'55.2"	Shale
SV7	14°31' 29.7"	78°32'00.1"	Olive Green Shale
SV8	14°20' 48.1"	78°24'03.6"	Basalt
SV9	14°24'40.9"	78°28'06.2"	Dolerite sill
SV10	14°26'04.8"	78°09'41.6"	Basalt

Discussion and conclusion:

The occur the different varieties of sills with in Tadipatri formation that can be litho logically separated.

The thick differentiated gabbro sills(Olivine gabbro to leucogabbro),long slender clinopyroxene phenocryst bearing doleritic sills are present in the lower and upper parts of the formation. The mesocratic doleritic sills are present at all stratigraphic levels within the Tadipatri formation .the gabbro are formed by the coarsegrained,finer grained dolerite sills occur mostly in the upper part of the formation.

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