DIGITAL ESTIMATION OF DUMPS OF MINING OVER BURDEN QUANTITIES IN OPEN CAST BARYTE MINE OF MANGAMPETA, ANDHRA PRADESH, INDIA

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ABSTRACT:

The Kadapa district of Andhra Pradesh state is one of the richest districts abounds in minerals with large reserves with high grade Barytes and uranium, industries and lust tropical forest. The district is famous for its Barytes mines in the country which is located in the Mangampeta mandal. In Mangampeta mining operations have been going on since 1976 by opencast mine method and waste overburden is removed and dumped in the nearby areas up to a distance of 6 km on either side of the road. The dumps are invariably associated with pockets of soil/carbonaceous tuff overburden or waste rock incorporated in to the tailings. Tailings, also called mine dumps, culm dumps, slimes, tails, refuse, leach residue or slickens, are the materials left over after the process of separating the valuable fraction from the uneconomic fraction of an ore. Tailings are distinct from overburden, which is the waste rock or materials overlying an ore or mineral body that are displaced during mining without being processed. Modern day mines, particularly in jurisdictions with well-developed mining regulations are operated by responsible mining companies, often incorporate the rehabilitation and proper closure of tailings areas in the mining costs and activities. For example, the Province of Quebec, Canada, requires not only submission of closure plan before the start of mining activity, but also the deposit of a financial guarantee equal to 100% of the estimated rehabilitation costs. The quantities and measurements of the mine and the overburden with mine dumps parameters are obtained from maps or field surveys. An attempt is made here to estimate the same using open source digital data and digital means of estimation using ASTER surface. The volume estimated through digital means and data sheet of the mine provided are in tandem to a satisfactory extent.

Key words: DEM, ASTER, Mine, Baryte, Dump.

INTRODUCTION

Man has unknowingly increased the trace element content of his environment in exploiting the reserves of minerals. Mining, in general, and open cast mining in particular may lead to severe environmental degradation. Paradoxically, from an environmental point of view, Barytes mining is a major

habitat transforming activity which has a number of detrimental environmental consequences, namely soil erosion, acid-mine drainage and increased sediment load as a result of abandoned and un-reclaimed mined lands (Parks et al.,1987). Besides, considerable amount of solid waste piled in the form of huge overburden dumps, destruction and degradation of forest and agricultural lands, and discharge of effluents from mines into nearby water-bodies are some of the other associated problems that have adverse environmental impact.

Geospatial Technology is a means for working with maps and geographic information. It is used for creating and using maps; compiling geographic data; analyzing mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the Web. The Kadapa district of Andhra Pradesh state is one of the richest districts abounds in minerals with large reserves with high grade Barites and uranium, industries and lust tropical forest. The district is famous for its sprawling Barites mines in the country which is located in the Mangampeta mandal. In Mangampeta mining operations have been going on since 1976 by opencast mine method and waste overburden is removed and dumped in the nearby areas up to a distance of 6 km on either side of the road. The dumps are invariably associated with pockets of soil/carbonaceous tuff overburden or waste rock incorporated in to the tailings. The granular barite beds overlain by a zone of lapilli barite and constitute the economically significant deposit with an estimated reserve of over 74 million tons. The approximate thickness of the over burden is 5.85 mts, which includes top soil (0.5-2.5m) followed by carbonaceous tuff. Earlier workers studied mineralogical (Kurienet al.1977), geochemical (Neelakantam, 1987;Basu, 1997), petrological (Viswanath and Sastry 1983) aspects of this mineralized area. Continuous monitoring on the nature, extent, spatial distribution pattern and temporal behavior of degraded lands including land subject to mining is, therefore, essential for their effective reclamation and management. This article has to describe the aspect of quantifying of mangampeta mine dump; excavated overburden and ensuing from the surface mining activities pose a long term impact on the environment and the land safety measures. Accurate quantification of the extent of the area occupied by the overburden is important for the assessment and proper restoration of the waste land. Substantial quantity of nonurban land monitored can be used to fill the excavated profile of the overburden using conceptual regarding analysis.

STUDY AREA

The mangampet barite deposit is situated in the crescent shaped cuddapah basin of Proterozoic age in the Indian shield. It is the single largest deposit in the world with over 25% of reserve. The study area falls between the latitude 14^0 01^1 N and longitude $79^0 19^1$ E. Also this deposit estimate reserve of over 74

million tonnes of barite holds about 98% of the total reserve in the cuddapah basin and 87% of the country reserve (Subba Rao 2004).

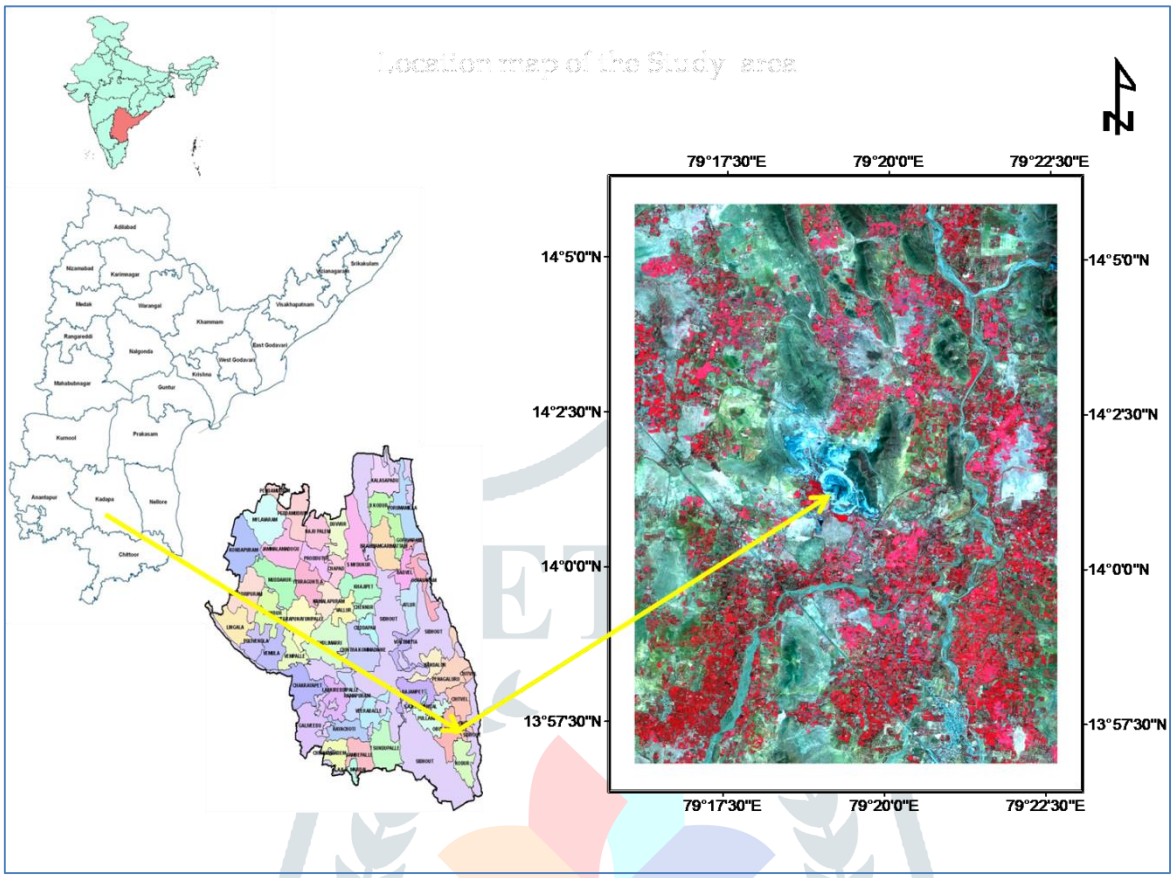
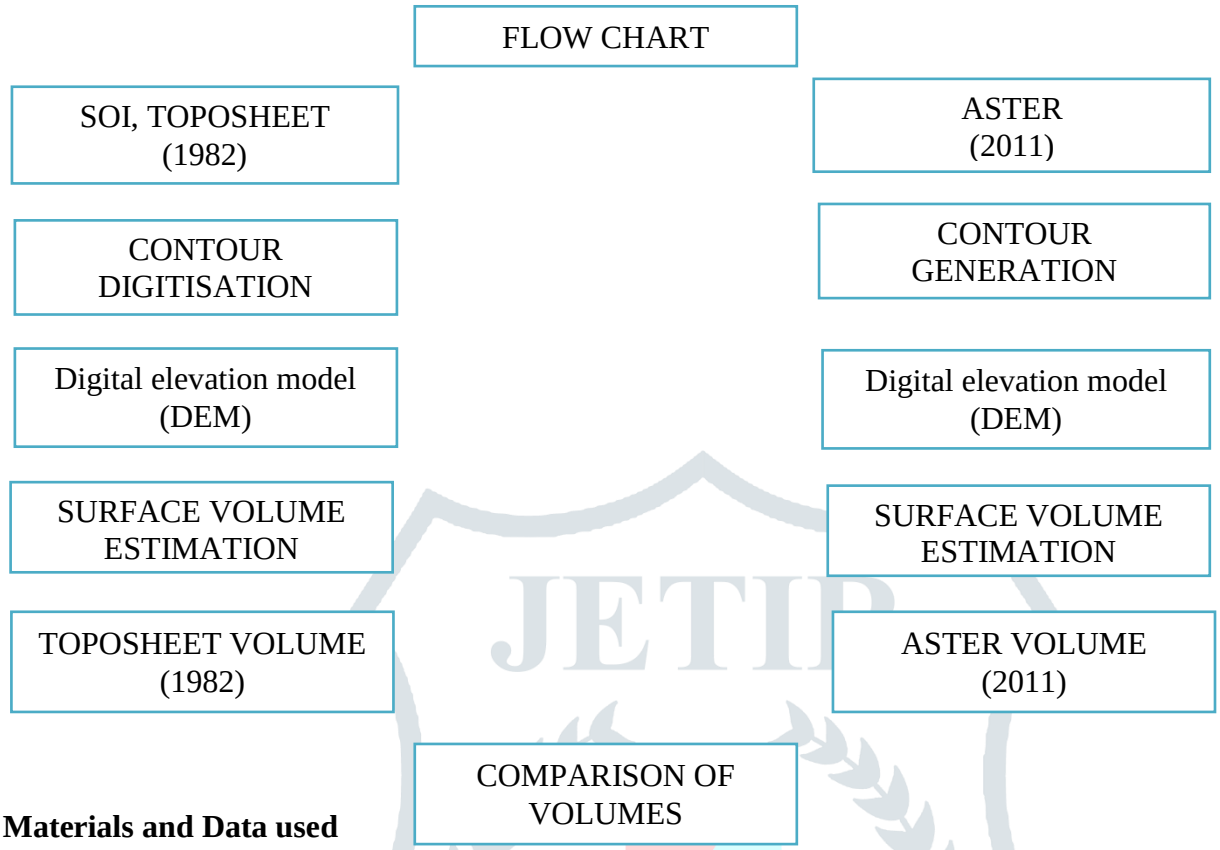


Fig. 1 Location map

At Mangampet barite occurs as 2 distinct entities; the northern lens and southern lens separated by a distance of about 700m. The northern lens has a strike length of 1200m in NNW-SSE direction and dipping 15^0 to 30^0 ENE/NE direction with maximum width of 900m and average thickness of 21m. It occurs as doubly plunging syncline. The southern lens spans a strike length of 300m with a maximum width of 220m and thickness of 4 to 10m. In the mangampet mine, four types of barites occurrence are recognised they are 1. Granular, 2. Lapilli, 3.Vein and 4. Replacement type. The granular barite bed is overlain by a zone of lapilli barites and constitute economically significant deposits. Coulson (1933), who carried out a detailed appraisal of barites occurrence in the ceded districts of the madras presidency, recorded an occurrence of barites near rajampeta town associated with the cheyair series which occupied a position higher in the stratigraphic sequence then the vempalli the formation with which all the barites occurrence were known to associated till thin. The mineral contains more than 99% $BaSO_4$, 0.046% Sulphur and 0.081% Carbon. One of the samples revealed the presence of 0.12% bituminous matter it is apparent that the sample referred by coulson was from near mangampeta. This happens to be first ever published recorded on the mangampeta barites.

METHODOLOGY:



Materials and Data used

Data collection is the most important of all steps in research. Scientific data collection methods, tested tools of data collection and reliable sources of data are essential for good research outcome. Any research work needs data. Data throw light on the problem, its dimensions, the solutions and their effectiveness. In this study we have planned to collect survey of India toposheets 57N08 and Aster and IRS P6 LISS III data. Details of the Satellite Data are as follows:

LISS-III data: (Linear imaginary self scanning sensor)

The LISS-III is a multi-spectral camera operating in four spectral bands, three in the visible and near infra-red and one in SWIR region, as in the case of IRS-1C/1D. The new feature in LISS-III camera is the SWIR band (1.55 to 1.7 microns), which provides data with a spatial resolution of 23.5m unlike IRS-1C/1D (the spatial resolution is 70m).the sections and characteristics of the LISS III data are given below in the table I.

ASTER Data: The ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) instrument of the Terra satellite is a freely available data that is generated from a pair of ASTER Level 1A images. This Level 1A input includes bands 3N (nadir) and 3B (aft-viewing) from the Visible Near Infra-Red telescope's along-track stereo data that is acquired in the spectral range of 0.78 to 0.86 microns. ASTER DEMs can be generated either with or without ground control points (GCPs). An Absolute DEM is created with GCPs that are supplied by an end-user who has requested the product. These DEMs have an absolute horizontal and vertical accuracy of up to 7 meters with appropriate GCPs and up to 10 meters without

GCPs. Alternatively, a Relative DEM can also be generated without GCPs. These DEMs can be used to derive absolute slope and slope aspect which is good up to 5 degrees over a horizontal distance of over 100 meters. ASTER DEMs are expected to meet map accuracy standards for scales from 1:50,000 to 1:250,000.

Data processing

Data processing includes the steps required for the final usage of multiple. The steps involve Terrain Patching of Aster data, enhancement of LISS III data and rectification & registration of both data. Occasionally it will be necessary to patch missing elevation data points in the digital elevation model. This is particularly true with the ASTER data, which may be sprinkled with obvious holes where elevation values are missing from the terrain grid. These holes can disfigure the 3D images of the terrain, and must be patched.

Generation and Interpretation of DEM

On an ASTER image, the elevation values can be easily identified by visual interpretation by generating a DEM. The interpretation of elevation in the form of DEM is based on the spatial correlation of remotely sensed images as well as on the contour density of the available Topographical maps. The generated DEM can also be correlated with the numerous reliefs maps such as Aspect, Hillshade, curvature etc.

Mapping and Analysis

These thematic maps are the true representation of earth's phenomena such as spatial distribution of natural resources existing at the time of survey (Gupta, 2003). In the present study different thematic maps in the form of DEM are generated and analysed particularly for 3D. These pre field thematic maps are modified substantiated and confirm after limited field checks.

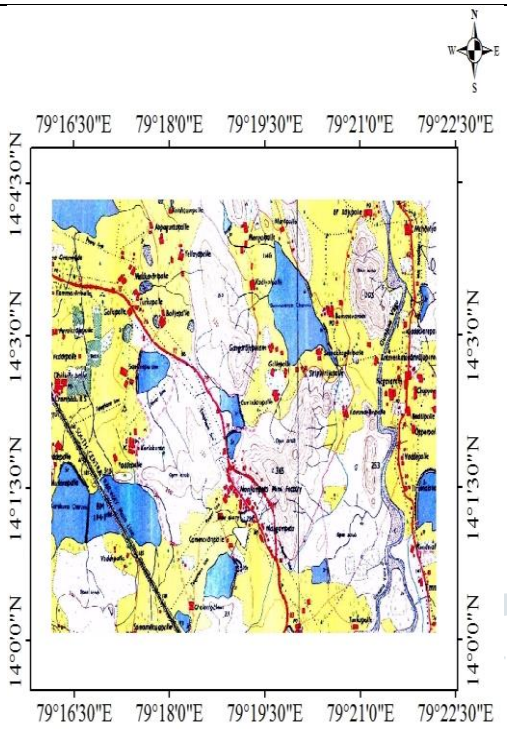


Fig 2. Toposheet

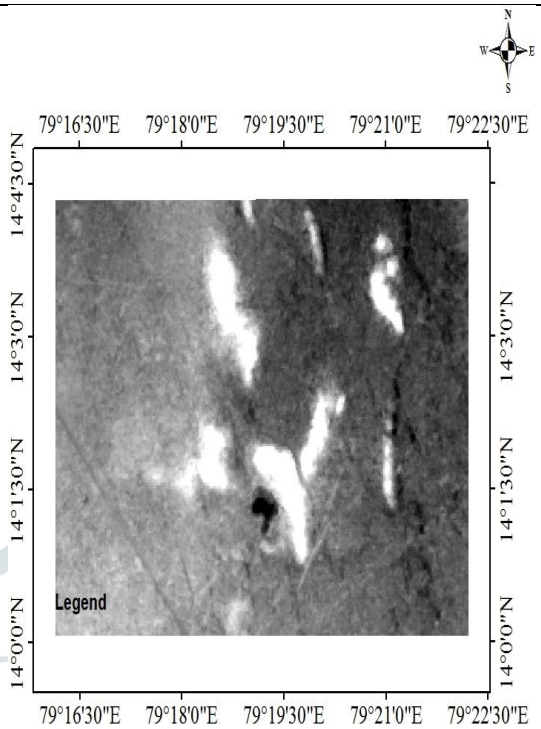


Fig 3. Aster data

Softwares and Field Equipments

The digital data were processed for geometric and radiometric corrections using ERDAS Imagine processing software. A number of softwares such as Arc GIS version 9.0, ERDAS Imagine version 9.1, 3 DEM and Microsoft office processing tools (Word, Excel) are used in the study. For processing ERDAS was considered useful. The field equipments and tools used for fieldwork include Brunton compass, Garmin e Trex H (GPS) receiver, slope meter, Dumpy level, tripod stand, levelling staff and measuring tape.

Results and Discussion

The idea of calculating the initial surface using toposheet contours and the surface obtained through the ASTER with a hypothetical uniform level is taken into account. It is assumed that the difference between the volumes of the two input data i.e., toposheet and ASTER with reference to the uniform level is the dump of the overburden produced from the mine. The values thus obtained are verified with the officially published data of the Mangampeta Baryte Mining Corporation namely APMDC (Andhra Pradesh Mineral Development Corporation). The detailed mapping of the processes involved is illustrated diagrammatically as follows in the sequential manner.

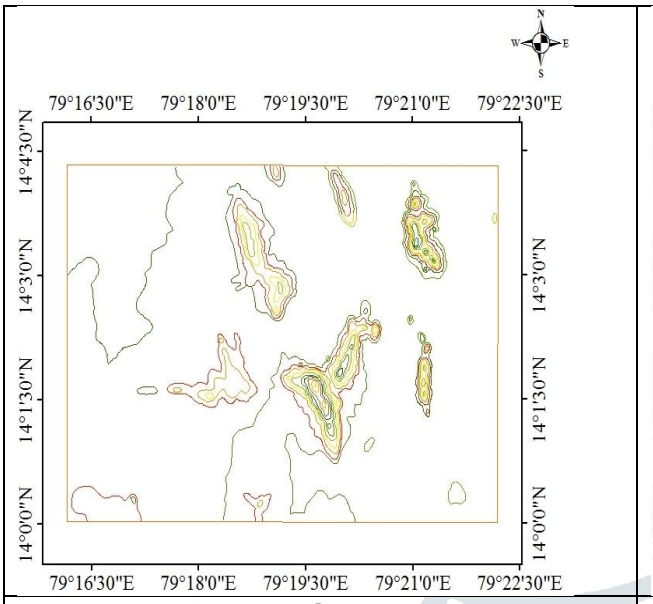


Fig 4. Toposheet Contour

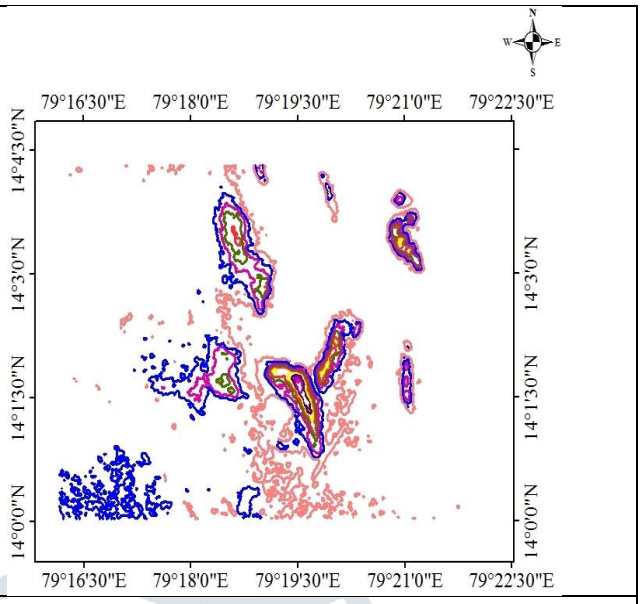


Fig 5. ASTER Contour

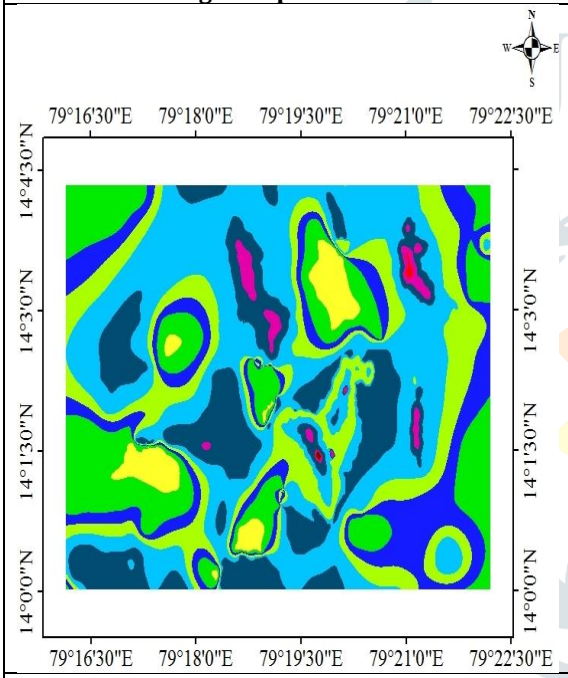


Fig 6 Contour DEM

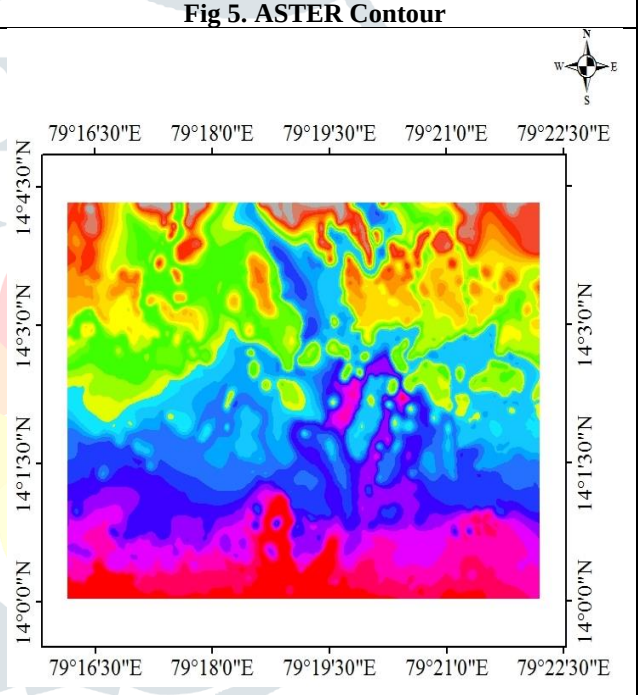


Fig 7. ASTER DEM

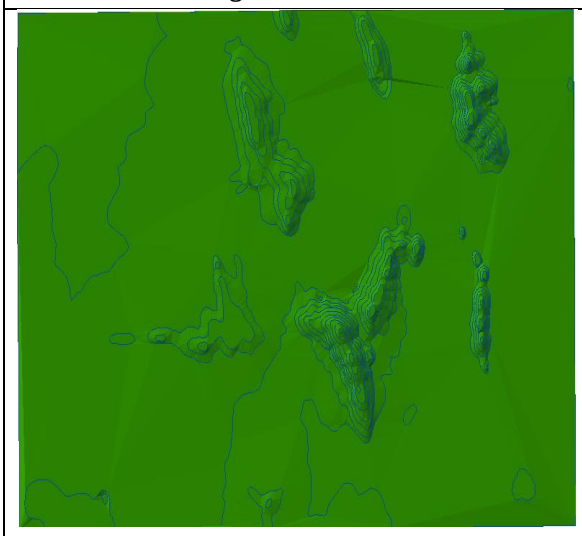


Fig 8 Toposheet TIN

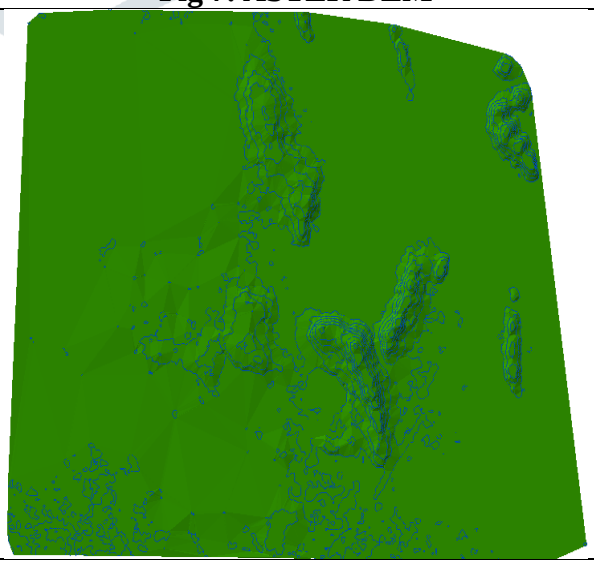


Fig 9 ASTER TIN

The initial volume with reference to the uniform hypothetical level calculated from Toposheet is 64,79,97,047 CBM and from the ASTER is 71,93,44,189 CBM and the difference is 7,13,47,142 CBM which is supposed to be the overburden that is dumped around the mining site. The dumping sites are established with the field visits of the study area before fixing the boundaries of the sites. The particulars of the officially published data of the APMDC are herewith mentioned in Table 1. as follows.

Year	Production of ROM in MTs	Removal of OB In CBM	Powder Production in MTs	Sale Particulars in Lakhs
1997-98	453267	2102266	23854.8	4416.37
1998-99	637957	3596684	8299.05	3129.71
1999-00	281525	2000975	30989.5	2079.84
2000-01	802721	4765482	27273	3656.49
2001-02	885456	5727642	10007	3755.23
2002-03	654161	6012493	15939	3609.38
2003-04	698161	3951371	11825	4064.33
2004-05	1134519	6643362	18816	6110.8
2005-06	1087886	6618002	17460	5739.64
2006-07	1636374	8190243.6	25272	8923.14
2007-08	1039211	1651257	11118	8561.37
2008-09	1640398	4729837	8758	14220.09
2009-10	2112474	14613042	13640	-

Table 1. Particulars of Mining by APMDC

Conclusion

The effort to apply Digital means of estimating the dump quantities using geospatial technology with this work is satisfactory and from the above table it is evident that the over burden removed from the mine form 1997 to 2010 is 7,06,02,656 CBM and the volume estimated from the difference of the ASTER and Toposheet is 7,13,47,142 CBM. The difference between the estimated volume and the published volume is approximately 1% which is convincing to input the ASTER data for volumetric analysis for rough estimation of the data.

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