1. ACCELERATOR

1.1 OPERATIONAL SUMMARY

S Chopra

The accelerator operation in this year had been smooth. There was no tank opening for breakdown maintenance inside accelerator. There were two scheduled tank opening for routine maintenance. The details of these maintenance are mentioned in maintenance section. The operational summary of the accelerator is as follows for period from 1st April 2006 to 31st March 2007.

Total No. of Chain Hours	=	6790 Hours
Total Beam utilization	=	4197 Hours
Machine breakdown	=	0142 Hours
Accelerator Conditioning	=	2440 Hours
Beam Change Time	=	0011 Hours

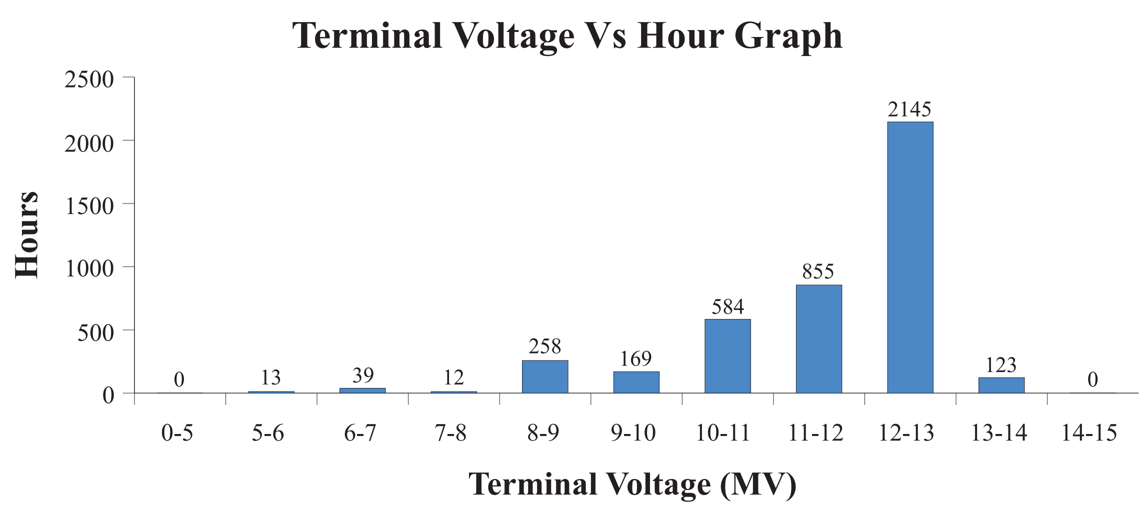

Fig. 1. Graph showing Terminal Voltage vs Duration Hours

Total number of 525 shifts were used for experiment during mentioned period. Out of these 525 shifts, 104 shifts were used for pulsed beam users. The machine uptime for this period is 97.90% and the beam utilization is 61.81%. The voltage distribution graph of Terminal Potential used for different experiments during above mentioned period is shown in figure 1. The maximum voltage achieved during conditioning in this year was 13.37 MV.

Accelerator performance, in the form of Pi-chart, is shown later in figure 2.

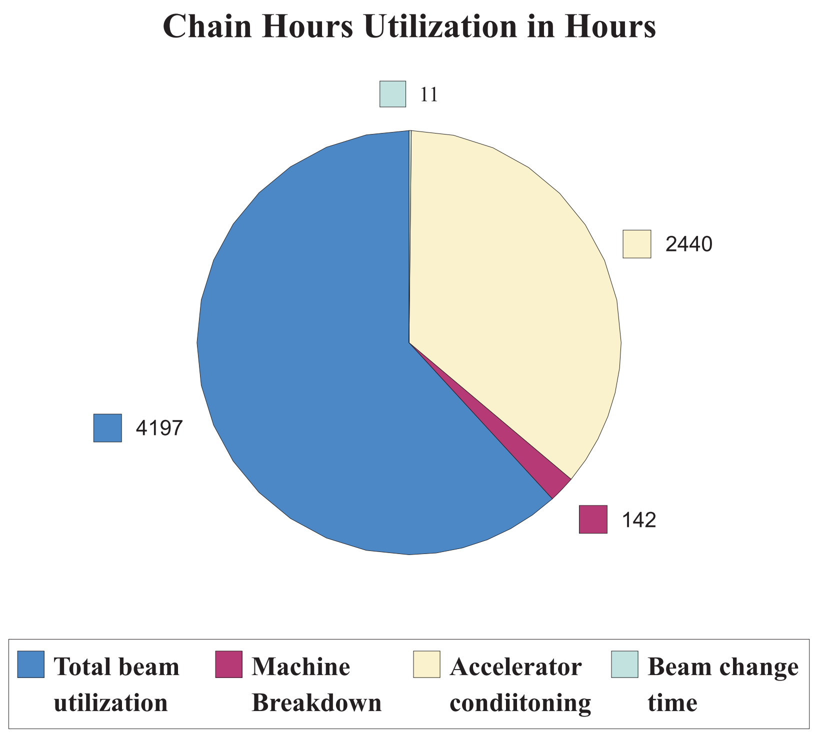

Fig. 2. Utilization hours

The total duration of beam run for mentioned period is 4197 hrs. Duration of run time in percentage for different ions is shown in table 1.

Beam delivered	Utilization (%age of total time)	Beam delivered	Utilization (%age of total time)
^{7}Li	3.71%	^{35}Cl	0.36%
^{9}Be	3.85%	^{40}Ca	3.45%
^{10}Be	0.98%	^{48}Ti	0.33%
^{10}B	2.33%	^{51}V	1.79%
^{11}B	3.12%	^{56}Fe	1.33%
^{12}C	5.09%	^{58}Ni	6.75%
^{14}N	0.20%	^{63}Cu	1.01%
^{16}O	13.69%	^{79}Br	0.54%
^{18}O	2.84%	^{107}Ag	14.18%
^{19}F	9.13%	^{127}I	0.24%
^{28}Si	12.34%	^{197}Au	12.74%

Table 1.

Pi- chart in figure 3 shows the distribution of delivered beam species during beam run from 1st April 2006 to 31st March 2007.

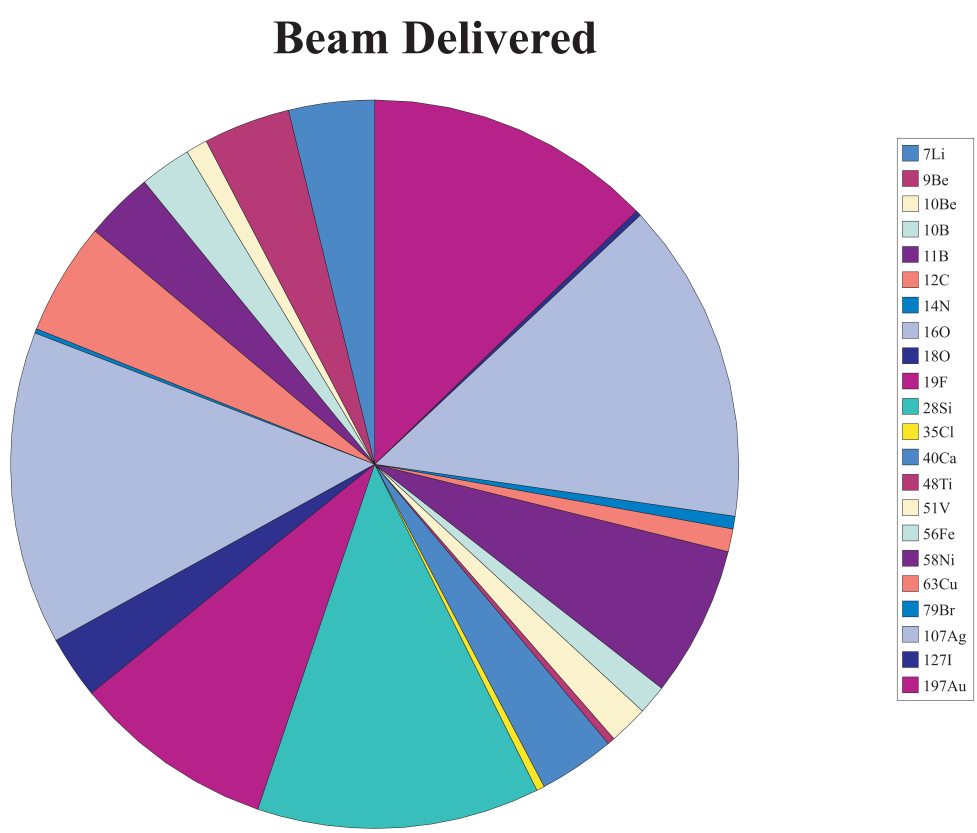

Fig. 3. Distribution of delivered beam species

1.2 MAINTENANCE AND DEVELOPMENT ACTIVITIES

S Chopra, R Joshi, S Gargari, M Sota, S Ojha, K Devarani, V P Patel, R P. Sharma, J Prasad, R Kumar, M P Singh, N S Panwar, S Mohan, Suraj Kumar, Pranav Singh, P Barua and A Kothari

There was only two scheduled tank opening maintenance from April 2006 to March 2007. The first schedule maintenance was from 6th June 2006 to 29th June 2006 and the second one was from 9th February 2007 to 23rd March 2007. The first maintenance was taken up after a duration of three months of operation. In these scheduled maintenance, routine maintenance like checking of resistor network inside tank, HV breakdown test of CSP gaps, foil stripper change etc. were carried out. Apart from these jobs, a few major maintenance work were also performed, which are listed later.

Major maintenance jobs during scheduled tank openings

The major maintenance jobs carried are listed below:

1. Charging system maintenance

Both the charging systems are operated and thoroughly checked. Very little idler dust was getting generated from both of the charging systems. The position and condition of all idler wheels of both of the charging systems was satisfactory, although alignment of a few of the idler wheels in charging system #2 was done. This alignment was done in unit #22 and 27. Carbon band of Pick-off wheel of charging chain #2, on downcharge side (doubler pick-off wheel), got dislodged from the wheel. This restricted the doubling of charge in charging system #2. This pick-off wheel is replaced by new one and properly aligned. Some pulley dust was also seen in terminal area. Both pulleys were properly cleaned and then were oiled. Both the charging systems were kept ON for four nights. The condition of both charging systems was satisfactory. No idler dust and no pulley dust was observed after overnight operations of chains.

2. Rotating Shafts bearing maintenance

One of the major maintenance works is the maintenance of the rotating parts of rotating shafts of the accelerator. Altogether fourteen separator boxes were opened and bearings of all of these separator boxes were changed. Out of these fourteen separator boxes, eight boxes were in low energy side and six were in high energy side of machine. Apart from this, rotating shaft motor #1 (RS - 1) was also replaced by a new motor as grease was leaked out from the bearing of this motor. After completing the maintenance of rotating shafts, the operation of both of the rotating shafts was observed to be smooth.

3. Replacement of blower motor

During the regular operation of accelerator, before tank opening of February 2007, blower motor was not operating. It was tripping off. To identify its cause, insulation of blower motor was tested with megger and found that all three of the windings of motor were showing short with the motor body. Therefore this blower motor was replaced by a new one.

4. Unit repairing

The resistances across gap #5 in unit #5, gap #18 in unit #6, gap #17 in unit #9, gap #18 in unit #9 and gap #4 in unit #16 were found to be low. Therefore all of these gaps were electrically shorted in order to save corresponding posts from further damage.

5. Column Support post change

There were severe cracks across the gap #16 and 18 of P-1 in unit #15. Minor cracks were also observed in P-2. Apart from this lots of CSP gaps were shorted in remaining posts. It was decided to change all four column support posts of unit #15. Hence, all four column support posts were replaced by a new one. This gave an advantage of four live column support post gaps.

6. *Fiber optic cable replacement*

Fiber optic cables, used to control the operation of devices in terminal and high energy dead section area, got damaged in the month of March 2006. All of these fiber cables were repaired using indigenously developed mechanical splicers. These repaired cables worked upto satisfaction for the proper operation of Pelletron. In June scheduled maintenance, these repaired fiber cables were replaced by new ones.

7. *Replacement of hoop screws*

Resistance between hoop screw heads and equipotential rings, for full accelerator column, was measured. Hoops screws, which had very high resistance, were replaced in few units.

8. *Annular Service Platform maintenance*

Annular Service Platform (ASP) used to vibrate at the time of stopping. As the stopping of ASP was not smooth, it created lots of difficulty in terminal shell movement work. To take care of this problem, new springs were added to all four ASP wheels. This helped to reduce the ASP vibrations.

Maintenance for electronics related problems

There were a few problems associated with the controllers of gas stripper, offset quadrupole (EQ T-1), and matching quadrupole (EQ T-2). In case of gas stripper full speed readback of gas stripper turbo pump was not coming. The problem was solved by changing corresponding light link card in terminal. A connector problem and problem in another light link card were identified as cause for the malfunctioning of EQ T-2. Both of these problems were taken care of to solve the problem of EQ T-2.

Vacuum problem in 02 area

Vacuum, read by vacuum gauge, was in the range of 10-5 T. The problem was thoroughly investigated and a small leak was found in fast valve (BLV 02-1). This valve was changed but still the vacuum did not improve. The problem was further investigated. A leak was found in one of the water lines feed-through of Multi Harmonic Buncher. This leak was of the order of 10-6 Torr-l/s. Sealant was sprayed to seal this leak.

1.3 ION SOURCE ACTIVITIES

S Chopra, R Joshi, S Gargari, M Sota, S Ojha, K Devarani, Pankaj Kumar, V P Patel, J Prasad, R Kumar, M P Singh, N S Panwar, S Mohan, Suraj Kumar, Pranav Singh, P Barua and A Kothari

The ion source operation was satisfactory from April 2006 to March 2007 with a few breakdowns. The source was opened four times during this duration. Three times the source was opened for breakdown maintenance and once for routine maintenance. The major maintenance performed is given below.

Maintenance work

1. Einzel lens problem

During August 2006 it was noticed that focus element voltage of einzel lens was following the extractor element voltage. Ceramic surface resistance of einzel lens was measuring zero with megger. Therefore the source was opened and einzel lens assembly was measured with spare one. The MC-SNICS source was dismantled and cleaned thoroughly. After cleaning it was assembled back, aligned and installed back.

2. Ionizer problem

During ^{18}O beam run in GDA line, beam disappeared suddenly. It was noticed that there was no ionizer current. The resistance of ionizer was checked and it was opened. The source was disassembled and the faulty ionizer was replaced by spare one. After this repair work, ^{18}O beam was again delivered to user.

3. No Cesium supply

After the completion of ^{18}O run, the source was not operating properly. There was some cathode current at the beginning but after operation for around 5 minutes it was reducing to a very small value. The problem was investigated and concluded that there was no cesium in the reservoir. The Cesium reservoir was opened and 5 gm. of fresh cesium was loaded. The reservoir was installed back to solve the problem.

4. MC-SNICS Ion source maintenance

The source was opened for maintenance during February 2007 scheduled tank opening maintenance. The source was totally disassembled. Each and every part of source was properly cleaned with scotch brite and alcohol. After thorough cleaning work the source was reassembled back and aligned. Apart from this, maintenance of ion source pumping was also taken up. Both rotary pumps, used for baking of two turbo pumps (TP 01-1 and TP 01-2), were replaced. Oil of both the turbo pumps was also changed. Cathode wheel of MC-SNICS was loaded with required cathodes for 17 times. Two newly developed beams, ^{40}Ca and ^{79}Br, were also delivered to users for the first time.

5. General Purpose Tube (GP tube) conditioning

All five General purpose tubes were cleaned thoroughly with alcohol and then it was conditioned. During conditioning X-ray activity was monitored in area monitor. Some electron current was also monitored in FC 01-1. After proper conditioning, now the General purpose tube is holding high voltage upto 350 kV.

Ion Source Test Bench facility

Indigenously developed electrostatic quadrupole and an electrostatic steerer were installed in the Ion Source Test Bench line. The main feature of this quadrupole is that it can work in singlet, doublet or in triplet configuration, as desired. The function of these quadrupole and steerer is to improve the beam optics after mass analyzer magnet. Controllers for these quadrupole and steerer were also developed in house. An experimental chamber is installed at the end of this line to check the quality of developed beam. Effect of these newly installed components was tested with ^{28}Si beam of different energies (from 40 keV to 100keV). Total beam currents from ion source and mass analyzed beam currents were observed at different parameters of newly installed quadrupole and steerer. It was observed that these components play major role in increasing the beam transmission. The quadrupole was operated in doublet as well in triplet configuration and beam transmission was maximum in triplet configuration. Beam spot of ~3 mm to 5 mm was also seen on CsI crystal, mounted on target ladder in the experimental chamber. 250 l/s turbo pump in ion source test bench is now replaced by 550 l/s turbo pump. This is done to improve the vacuum in source side. This reduces the breaking of filament of ionizer and helps to enhance the life of ionizer.

1.4 BEAM PULSING SYSTEM

R Joshi, S Ojha, M Sota, V Patel, R Kumar and A Sarkar

Operation

Pulsed beam was delivered to user for the total number of 104 shifts. The beam which were bunched for these pulsed beam runs were ^{16}O, ^{19}F, ^{28}Si and ^{40}Ca. Out of these 104 shifts, 5 shifts were for ^{16}O pulsed beam run, 43 shifts for ^{19}F, 38 shifts for ^{28}Si and 18 shifts for ^{40}Ca pulsed beam run. ^{40}Ca pulsed beam run was delivered for first time to user. Multi harmonic buncher is used for all the pulsed beam runs. 4 MHz chopper in pre acceleration section was used to eliminate the dark current as the repetition rate required by user was 250 ns. Traveling wave deflector (TWD) was also used, along with chopper and multi harmonic buncher, to get different repetition rates other than 250 ns ^{28}Si pulsed beam was used for LINAC run. For this run high energy sweeper was used, instead of pre-acceleration chopper, to get rid of dark current. All the beam pulsing systems worked satisfactorily for all experiments.

Maintenance

Breakdown maintenance of traveling wave deflector (TWD) was done once. Out of twelve, three of its channels were repaired. TWD was effectively used in one of the pulsed beam runs after this maintenance.

1.5 DEVELOPMENT ACTIVITIES

B Kumar, S Ojha, R Joshi and S Chopra

Fabrication of newly designed chiller inside tank: A chiller is used inside accelerator tank to regulate the temperature inside tank environment around 25 degree. C. This chiller is quite old (~15 years) and housed inside tank. It is planned to replace this by a new one which can be housed outside accelerator tank. This is done to avoid any kind of accident which may occur during the operation of accelerator. A chiller for this purpose is designed and fabricated. Fabrication of this chiller is done by a local vendor (Air Fridge). Proper inspection of this chiller was carried out during its fabrication.

This newly fabricated chiller is now installed to control the inside tank temperature. Presently the old chiller is still in circuit. The arrangement is done in such a way that new chiller can be bypassed while old chiller is used. This is done for initial testing of new chiller. Chilled water pipe line for chiller is also newly installed. Chilled water pipe line, chiller and gas line of new chiller are properly insulated for efficient cooling. The performance of new chiller is tested. To observe its performance, chilled water supply to old chiller is stopped and there is proper supply of chilled water to only new chiller. In this way, effectively, only new chiller is active. It was noticed that new chiller was able to regulate the temperature inside tank environment at around 25 °C.

1.6 ACCELERATOR MASS SPECTROMETRY (AMS)

Pankaj Kumar, K.Devarani, Sunil Ojha, A.Jhingan, S.Gargari, R.Joshi, T.K. Nandi, S.Chopra and S.K. Datta

AMS facility measurement has been in operation since last year and this year some experiments were performed for ^{10}Be with Sediment and Mn Nodule samples. In the stable isotope AMS work, depth profiling of ^{63}Cu in Si substrate were also performed to check the reproducibility. Progresses in AMS activities are being reported.

1.6.1 Modifications made in the system

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Last year we have carried out ^{10}Be AMS experiments with standard and geological samples using sequential measurement technique. After making some modifications in Offset Faraday Cup (OFC), we performed the ^{10}Be AMS experiments with sediment sample. In simultaneous measurement method, mass 26 (mainly consisting of $^{9}Be^{17}O$ and $^{10}Be^{16}O$) is injected and if analyzer magnetic field is set for $^{10}Be^{3+}$ then $^{17}O^{5+}$ (representative of ^{9}Be) comes out from analyzer magnet at an offset angle, which is collected with Offset Faraday Cup (OFC). In new OFC set up, OFC is installed at a fixed angle of ~2^0 as predicted by the theoretical calculations. In AMS facility testing, OFC operation was checked and its position optimization was done with visible ^{16}O beam with respect to FC-04.

In the detection system we have a Multi Anode Gas Ionization Chamber (MAGIC), which has five spilt anodes, Frisch grid, cathode and one Silicon Surface Barrier Detector (SSBD). In earlier ^{10}Be detection experiments we have been using it in dE-Eres mode i.e. all anodes shorted to give one dE signal and SSBD as Eres, but because of the small active area of SSBD there was a transmission loss which was responsible for the low count rate and therefore required much more time to get reasonable statistics. This time MAGIC was used in gas-gas mode i.e. anode 1, 2, 3 and 4 all together make dE signal and 5th anode as Eres and this modification increased the

^{10}Be count rate. In MAGIC, old Frisch grid was replaced with new one.

1.6.2 Preliminary study of ^{10}Be from Lake Sediments

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Lake sediments contain ^{10}Be from two sources - material deposited directly from atmosphere plus material associated with dust, soil and sand of continental origin. The deposition of successive layers of sediments in Lakes provides a better understanding about rate of deposition and age of sediments. An attempt has been made to measure the atmospheric deposition of ^{10}Be in Kaluveli lake sediments, situated 15 km north of Pondicherry. Sediment samples were collected at different level upto 4.3m depth using a hand auger. Four selected samples were prepared for ^{10}Be analysis using cold digestion, spike addition and successive cation-anion exchange column separation method. The cold digestion method is a part of sequential extraction method to extract only atmospheric ^{10}Be, which is present in organic, carbonate and ferric oxide phases. The residual part mainly consisting silicate minerals contain ^{10}Be produced insitu during exposure of rocks in the continents. ^{10}Be analysis was carried out by simultaneous measurement of ^{10}Be and ^{9}Be using accelerator mass spectrometry. The result indicates that the ^{10}Be concentration decreases with depth (see Fig 1) as expected due to decay of ^{10}Be in the older sediments. The fig 1.shows decreasing pattern of ^{10}Be/^{9}Be concentration in sediment samples with respect to increment in the depth and shows the older sediment sample has lesser ^{10}Be than the new sample. It is due to the reason as there is no ^{10}Be input at lower depth as well as there is continuous decay of radioactive ^{10}Be also. The results are being processed to model the sedimentation rate in the Kaluveli Lake.

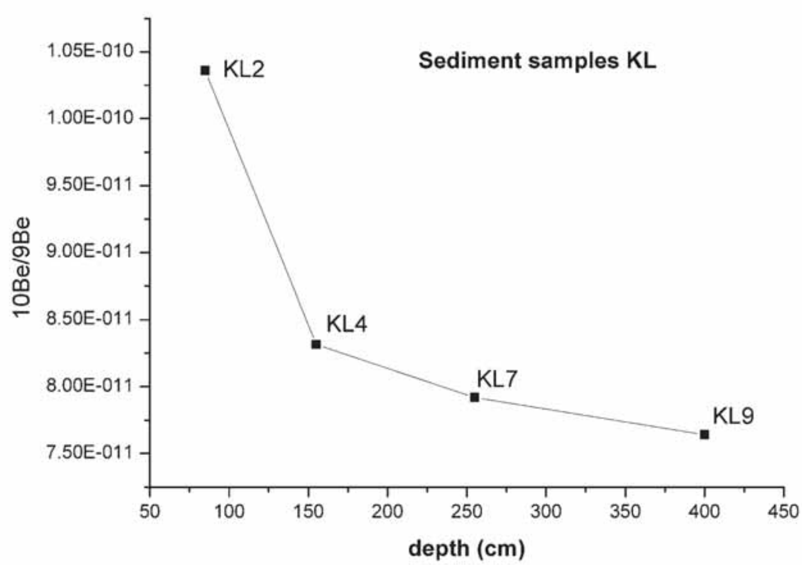

Fig. 1. Decreasing pattern of ^{10}Be/^{9}Be concentration in sediment samples with respect to increment in the depth

1.6.3 BeO Sample preparation for ^{10}Be analysis from geological material

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Ultra clean separation of ^{10}Be from geological sample is essential to reduce the matrix, which lowers ionization efficiency and also increases interface during measurement. To achieve this proper chemical separation procedure has been designed for routine measurement of ^{10}Be from Mn-nodules and sediments. Three different layers, outermost layer – P1, middle layer – P2 and inner layer- P3, are removed from a Mn-nodule for ^{10}Be analysis (Fig.2). Total thickness of three layers is 6mm and layers were scraped physically and 500mg of 200 mesh size powder were taken for digestion separately. In case of sediment sample, 4 selected layers KL2, KL4, KL7 and KL9 (Fig.1) from Kaluveli lake sediment core were processed for ^{10}Be analysis. Sediments were dried down completely at 100º C for overnight, powdered to 200mesh size and 2g samples from each layer was taken for sequential extraction of ^{10}Be after removing organic matter chemically. Here absorb ^{10}Be from organic, carbonate and ferric oxide phases were taken collectively for the analysis and residual part was discarded by centrifuging. ^{9}Be spike was added to the samples after digestion for both Mn-nodule & sediment samples and followed by the successive cation-anion exchange column separation of beryllium using different concentration of HCL, HNO_3 and H_2SO_4 acids. By hydroxide precipitation method beryllium was separated from solution and heated up to 800º C stepwise to covert BeO for loading in to the cathode. Ag/Nb powder was added with BeO during cathode loading to enhance ionization efficiency. All the sample preparation and chemical separation work has been done in the ultra clean lab of the department of earth sciences, Pondichery University.

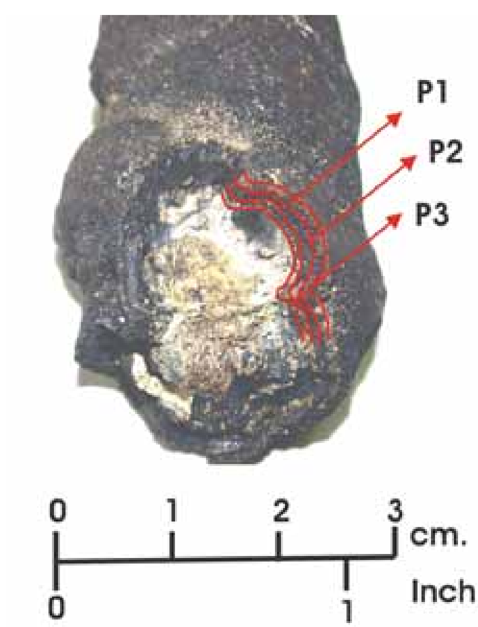

Fig.2. Different deposition layers in Mn Nodule sample