Many minerals are known to contain lanthanoids (Table 4). The symbols Ce and Y in the table represent the elements in cerium group and yttrium group, respectively. Out of the list of the mentioned minerals, only two, namely, monazite and bastnasite are of commercial importance. Monazite is sparsely distributed in various rocks but, due to its high density and inertness, it is concentrated by weathering into sand or beaches, usually in presence of other similar minerals such as cassiterite (SnO_2). Their rich deposits occur in Travancore, South Africa, Brazil, Malaysia, the U.S.A and Australia. In fact, before 1960, monazite was the only source of lanthanoids. However, a vast deposit of bastnaesite was explored in the Mountain Pass, California has since then become the most important single source of lanthanoids. Apart from the U. S. A. it is also found in Madagascar.

Table 4: Important Minerals of Lanthanoids

Minerals	Composition	Location of significant deposits
	(1) Cerium group minerals	
(i) Monazite Sand- Mixture of ortho-phosphates of Ce-earths, $(Ce)PO_4$	50-70% Ce-earths(i.e. elements of at. no. 57 to 62 calculated as oxides) 1-4% Y-earths (i.e. elements of at. no. 63 to 71 calculated as oxides) 5-10% ThO_2 1-2% SiO_2 22-30% P_2O_5 Traces of U	Occurs in the sand beaches of Travancore(India) Brazil South Africa U.S.A.
(ii) Bastnaesite-cerium earth fluoro-carbonate,$(Ce)FCO_3$	65-70% Ce-earths, < 1% Y-earths	Sweden, California, New Maxico
(iii) Cerite-A hydrated silicate of the composition, $(Ce)_3\, M^{II}\, H_3Si_3O_{11}$(M-Ca,Fe)	Traces of thorium 51-72% Ce-earths 7.6% Y-earths Traces of Th, U, Zr	Sweden Caucausus
	(2)Yttrium group minerals	
(i) Gadolinite or Ytterbite- A ytterium-earth, iron and beryllium silicate, $(Fe, Be)_3\, (Y_2)\, Si_2\, O_{10}$	35-48% Y-earths (Calculated as oxides) 2-17% Ce-earths Upto 11.6% BeO Traces of ThO_2	Sweden, Norway USA(Texas and Colorado)
(ii) Xenotime –An orthophosphate of Y-earth(analogous to Monozite), (Y), PO_4	54-65% Y-earths ~ 0.1% Ce-earths Upto 3% ThO_2, upto 3.5%U_3O_3 2-3% ZrO_2	Norway Brazil
(iii) Euxenite- Mixture of titanates, niobates and tentalates of Y-earths, (Y) (Nb, Ta) $TiO_6 . XH_2O$	13-35% Y-earths (Calculated as Oxides) 2-8% Ce-earths (Calculated as Oxides) 20-23% TiO_2, 25-35% $(Nb, Ta)_2O_5$	Australia, Idaho(U.S.A.)

orbitals, namely, z^3, xz^2, yz^2, xyz, $z(x^2 - y^2)$, $x(x^2 - 3y^2)$ and $y(3x^2 - y^2)$. The general set f orbitals are illustrated in fig. 4. Since there are seven such orbitals, each with a capacity of two electrons, a total of fourteen elements of this f - type series may result before the 5d orbitals starts filling up again. This accounts for the elements cerium through lutetium (Z = 58 to 71).

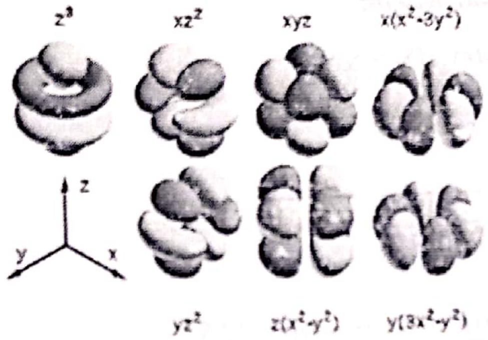

Fig.4: Shape of seven f orbitals

The electronic configuration is established on the basis of the emission spectra of the element under consideration. If the spectrum is simple, containing only a few lines, its interpretation becomes easier and the correct ground state configuration can be established for the atom in question. However, the emission spectra for many lanthanoids is highly complex, making the establishment of an absolutely correct configuration extremely difficult. The difficulty arises due to the fact that the 5d and 4f orbitals have comparable energy, so that the distinction between the two is not easy. The configuration of the lanthanoids is summarized in table 5.

Table 5: Ground state electronic configuration of Lanthanoids

Element	Atomic number (z)	Electronic configuration Idealized	observed
La	57	$[Xe]5d^1 6s^2$	$[Xe]5d^1 6s^2$
Ce	58	$[Xe]4f^1 5d^1 6s^2$	$[Xe]4f^1 5d^1 6s^2$
Pr	59	$[Xe]4f^2 5d^1 6s^2$	$[Xe]4f^3 6s^2$
Nd	60	$[Xe]4f^3 5d^1 6s^2$	$[Xe]4f^4 6s^2$
Pm	61	$[Xe]4f^4 5d^1 6s^2$	$[Xe]4f^5 6s^2$
Sm	62	$[Xe]4f^5 5d^1 6s^2$	$[Xe]4f^6 6s^2$
Eu	63	$[Xe]4f^6 5d^1 6s^2$	$[Xe]4f^7 6s^2$
Gd	64	$[Xe]4f^7 5d^1 6s^2$	$[Xe]4f^7 5d^1 6s^2$
Tb	65	$[Xe]4f^8 5d^1 6s^2$	$[Xe]4f^9 6s^2$ or $[Xe]4f^8 5d^1 6s^2$
Dy	66	$[Xe]4f^9 5d^1 6s^2$	$[Xe]4f^{10} 6s^2$
Ho	67	$[Xe]4f^{10} 5d^1 6s^2$	$[Xe]4f^{11} 6s^2$
Er	68	$[Xe]4f^{11} 5d^1 6s^2$	$[Xe]4f^{12} 6s^2$
Tm	69	$[Xe]4f^{12} 5d^1 6s^2$	$[Xe]4f^{13} 6s^2$
Yb	70	$[Xe]4f^{13} 5d^1 6s^2$	$[Xe]4f^{14} 6s^2$
Lu	71	$[Xe]4f^{14} 5d^1 6s^2$	$[Xe]4f^{14} 5d^1 6s^2$