CLAIMS

1. A clay composition comprising intercalated modified and calcined smectite clay comprising:

(a) pillars comprising aluminum and:

(i) at least one rare earth or lanthanide group metal; or

(ii) at least one rare earth or lanthanide group metal and gallium; and

(b) said clay comprising at least one ion-exchanged metal selected from the group consisting of magnesium, and zinc; and

wherein said clay is characterized by a basal d_{001} spacing equal to or greater than 18.5 angstroms and equal to or less than about 100 angstroms.

2. The clay composition of claim 1 wherein the pillars comprise at least one of cerium or lanthanum.

3. The clay composition of any one of claims 1-2 comprising at least one deposited metal selected from the group consisting of catalytically active transition metals of Groups 3-10 of the Periodic Table and optionally at least one organoaluminum compound.

4. A process for producing a clay composition comprising intercalated modified and calcined smectite clay comprising steps:

(A) contacting an aqueous slurry comprising smectite clay with an aqueous pillaring agent comprising aluminum and: (i) at least one rare earth or lanthanide group metal; or (ii) at least one rare earth or lanthanide group metal and gallium; to form a solids-containing phase and an aqueous phase;

(B) separating the solids-containing phase from the aqueous phase formed in (A);

(C) contacting the separated solids obtained in (B) at least once with an aqueous Met_mX_n composition comprising at least one Met_mX_n compound, wherein Met_m is at least one metal ion selected from the group consisting of magnesium and zinc, and X_n comprises at least one anionic species; and m and n = numerals that together satisfy the valence requirement for the combination of Met_m and X_n, to form a mixture comprising a solids-containing phase and an aqueous phase;

(D) separating the aqueous phase formed in (C) in order to form a new solids-containing phase;

(E) drying the separated, solids-containing phase from (D) in order to obtain dry solids and reducing said dry solids to a dry, particulate form; and

(F) calcining the dry, particulate from (E) to form a dry, pillared, solid catalyst support-activator in particulate form.

5. The process of claim 4 comprising in step (B), repeatedly extracting with water the solids-containing phase separated from the aqueous phase formed in step (A) and separating the water from the solids until the separated water is free or substantially free of: (i) residual anions originally present in the aqueous pillaring agent; or (ii) unconsumed pillaring agent or byproduct thereof; or (iii) both (i) and (ii);

in step (D), contacting and mixing the new solids-containing phase with a new portion of aqueous Met_mX_n composition, wherein Met and X_n are the same or different chemical species as selected in (C) and mixing and separating the resulting mixture comprising a solids-containing phase and an aqueous phase; and optionally repeating step (D) at least one additional time, wherein following the last mixing and contacting with the Met_mX_n composition, water-washing by introducing distilled or de-ionized water to the separated solids-containing phase to form a solids-containing composition, mixing and separating the composition into a solids-containing phase and an aqueous phase; and

repeating the water-washing until the aqueous phase is free or substantially free of X_n ions in order to obtain a washed solids-containing phase;

wherein free or substantially free is confirmed by a conductance value of less than 20,000 μS/cm or a negative $AgNO_3$ test result, or both.

6. The process of claim 4 or claim 5, wherein X_n comprises at least one anionic species independently selected from the group consisting of a halide selected from the group consisting of chloride, iodide, fluoride and bromide; bromate; chlorate; perchlorate; sulfate; sulfamate; carbonate; hydrogen-carbonate; carbamate; nitrite; nitrate; oxalate; phosphate; selenate; sulfamate; azide; alkoxide; amide, including NR_2 or $R[CON(R)]_a$, wherein R is independently H or a C_1-C_{20} unsubstituted or substituted hydrocarbyl group and a=1-4; and carboxylate, including $R[CO_2]_b$, wherein R is independently H or a C_1-C_{20} unsubstituted or substituted hydrocarbyl group and b=1-4.

7. The process of any one of claims 4 to 6 wherein Met_mX_n is selected from the group consisting of MgF_2, $MgCl_2$, $Mg(OAc)_2$, $Mg(NO_3)_2$, $ZnCl_2$, $ZnSO_4$, and mixtures thereof.

8. The process of claim 7 wherein Met_mX_n is $MgCl_2$ or $ZnCl_2$ or a mixture of $MgCl_2$ and $ZnCl_2$.

9. The process of any one of claims 4 to 8 wherein following separation of the solids-containing phase in (B), the solids-containing phase is extracted at least once with water.

10. The process of claim 9 wherein water extraction is repeated until upon separation from the solids, the separated water is free or substantially free of: (i) residual anions originally present in the aqueous pillaring agent; or (ii) unconsumed pillaring agent or byproduct thereof; or (iii) both (i) and (ii); wherein free or substantially free is confirmed by a conductance value of less than 20,000 μS/cm or a negative $AgNO_3$ test result, or both.

11. The process of claim 7 or claim 8 wherein contacting with Met_mX_n is carried out from 2 to about 10 times, and wherein Met_mX_n used in more than one contacting step is the same or different as Met_mX_n used in a prior contacting step, and including a separating step as in (D) between one or more contacting step.

12. The process of any one of claims 7-11, wherein the pillaring agent is selected from the group consisting of a basic aluminum complex, a basic zirconium complex, a basic chromium complex and mixtures thereof.

13. The process of any one of claims 7-12, wherein calcining is conducted at a temperature in the range of about 110°C to about 800°C for about 1 hr. to about 10 hrs.

14. An intercalated modified and calcined smectite clay catalyst support-activator for a metallocene olefin polymerization catalyst in the absence of an aluminoxane or borate activator, said catalyst support activator comprising:

intercalated modified and calcined smectite clay comprising:

(a) pillars comprising aluminum and:

(i) at least one rare earth or lanthanide group metal; or

(ii) at least one rare earth or lanthanide group metal and gallium; and

(b) said clay comprising at least one ion-exchanged metal selected from the group consisting of aluminum, barium, calcium, cerium, cesium, copper, chromium, gadolinium, gallium, germanium, hafnium, holmium, iron (II and III), lanthanum, lithium, magnesium, manganese, neodymium, potassium, praseodymium, rubidium, samarium, silver, selenium, sodium, strontium, tellurium, terbium, thallium, thorium, tin, titanium, uranium, ytterbium, yttrium, zinc and zirconium; and

wherein said clay is characterized by a basal d_{001} spacing equal to or greater than 18.5 angstroms and equal to or less than about 100 angstroms.