CLAIMS:

1. A cyclic process for selectively separating H_2S from a feed gas mixture comprising CO_2 and H_2S, which process comprises:

a) contacting the feed gas mixture under sorption conditions with a non-aqueous sorbent comprising a basic non-protogenic, ~~nitrogenous~~ tertiaryaminosiloxane compound grafted onto a mesoporous solid oxide having surface silanol groups selected from MCM-41, MCM-48, SBA-1, SBA-2, SBA-3, SBA-15, KIT-1, KIT-5, KIT-6, and combinations thereof, which sorbent reacts with at least a portion of the H_2S in the feed gas mixture;

b) sorbing the H_2S ~~into~~/ and some of the CO_2 onto the ~~sorbent~~ adsorbent, wherein the nonaqueous adsorbent has a selectivity for H_2S over CO_2 under the adsorption conditions;

c) subjecting the ~~sorbent~~ adsorbent to desorption conditions by which at least a portion of the sorbed H_2S is desorbed; and

d) retrieving an H_2S-rich product stream that has a higher mol% of H_2S than the feed gas mixture.

~~2. A process according to Claim 1 in which the basic nitrogenous compound comprises a tertiary amine (*e.g.*, triethylamine, triethanolamine, and/or methyldiethanolamine), an amidine, a guanidine, a biguanidine, or a combination thereof.~~

~~3. A process according to claim 1 or claim 2 in which the basic nitrogenous compound is supported on a porous solid (*e.g.*, a mesoporous and/or macroporous solid oxide such as silica, including MCM-41, MCM-48, SBA-1, SBA-2, SBA-3, SBA-15, KIT-1, KIT-5, KIT-6, and combinations thereof).~~

~~4. A process according to claim 3 in which the basic nitrogenous compound is grafted onto the porous solid by chemical reaction.~~

~~5.~~2. A process according to ~~any one of the previous claims, wherein the sorption and desorption steps are conducted at different temperatures and/or wherein~~ claim 1 in which the sorption and desorption steps are conducted at different pressures~~, such that one or more of~~

~~(a)~~ wherein the total pressure of the desorption step is lower than the total pressure of the sorption step.~~;~~

~~(b) the partial pressure of H_2S in the desorption step is less than the partial pressure of H_2S in the sorption step, and~~

~~(c) the pressure in the sorption step is such as to cause CO_2 to be sorbed from the gas stream in addition to the H_2S.~~

3. A process according to claim 1 in which the sorption and desorption steps are conducted at different pressures wherein the partial pressure of H_2S in the desorption step is less than the partial pressure of H_2S in the sorption step.

4. A process according to claim 1 in which the sorption and desorption steps are conducted at different temperatures.

~~6.~~5. A process according to ~~any of the previous claims~~ claim 1 in which at least a portion of the sorbed H_2S is desorbed by a non-sorbing inert purge gas and/or by a displacement purge gas.

~~7.~~6. A process according to ~~any one of the previous claims~~ claim 2 in which desorption is carried out in at least two steps under conditions of different pressure in each step with the pressure of the first desorption step being higher than the pressure of the second desorption step so that most of the CO_2 ~~sorbed~~ adsorbed in the ~~sorption~~ adsorption step is desorbed in the first desorption step and most of the H_2S ~~absorbed~~ adsorbed in the ~~sorption~~ adsorption step is desorbed in the second desorption step.

~~8.~~7. A process according to ~~any one of the previous claims~~ claim 1 in which the process is operated cyclically between the ~~sorption~~ adsorption and desorption conditions with a total cycle time of less than one minute.

~~9.~~8. A process to ~~any one of the previous claims~~ claim 1 in which the CO_2 and H_2S partial pressures during the ~~sorption~~ adsorption step are less than about 1 bar.

~~10.~~9. A process to ~~any one of the previous claims~~ claim 1 in which the feed gas mixture contains less than 5 mol% water.

~~11. A process according to any one of the previous claims further comprising a step of retrieving a feed gas product stream that has a lower content of H_2S than in the feed gas mixture, wherein (a) the feed gas mixture contains from about 10 vppm to about 10,000 vppm H_2S and the feed gas product stream contains less than about 4 vppm H_2S and/or (b) the feed gas mixture contains at least 5 mol% CO_2 and the feed gas product stream contains at most 5 mol% less CO_2 than the feed gas mixture.~~

~~12.~~10. A cyclic process for selectively separating H_2S from a natural gas feed stream comprising H_2S and CO_2, which process comprises:

(i) contacting the natural gas feed stream under H_2S ~~sorption~~ adsorption conditions with a non-aqueous ~~sorbent~~ adsorbent comprising a basic non-protogenic, ~~nitrogenous~~ tertiaryaminosiloxane compound grafted onto a mesoporous solid oxide having surface silanol groups selected from MCM-41, MCM-48, SBA-1, SBA-2, SBA-3, SBA-15, KIT-1, KIT-5, KIT-6, and combinations thereof wherein the non-aqueous adsorbent has a selectivity for H_2S over CO_2 under the conditions;

(ii) reacting at least a portion of the H_2S in the natural gas feed stream with the sorbent so that the H_2S is absorbed by the ~~sorbent~~ adsorbent;

(iii) retrieving a natural gas product stream having a lower content of H_2S in mol% than the natural gas feed stream;

(iv) subjecting the ~~sorbent~~ adsorbent containing the ~~sorbed~~ adsorbed H_2S to desorption conditions by which at least a portion of the H_2S in the sorbent is desorbed from the sorbent;

(v) retrieving an H_2S rich product stream that has a higher mol% of H_2S than the natural gas feed stream;

(vi) passing at least a portion of the H_2S-rich product stream to a Claus plant; and

(vii) recovering sulfur from the H_2S in the side stream.~~, wherein the natural gas product stream has a lower content of H_2S in mol% than the natural gas feed stream, and wherein optionally a greater mol% of H_2S is sorbed by the basic compound than CO_2 sorbed by the sorbent.~~

~~13.~~11. A process according to claim ~~12~~ 10 wherein

~~(a)~~ the natural gas feed stream contains from about 10 vppm to about 10,000 vppm H_2S and the natural gas product stream contains less than about 4 vppm H_2S. ~~and/or~~

~~(b) the natural gas feed stream contains at least 5 mol% CO_2 and the natural gas product stream contains at most 5 mol% less CO_2 than the natural gas feed stream.~~

12. A process according to claim 11 wherein the natural gas feed stream contains at least 5 mol% CO_2 and wherein the natural gas product stream contains at most 5 mol% less CO_2 than the natural gas feed stream.

~~14.~~13. A process according to claim ~~12 or claim 13 wherein the sorption and desorption steps are conducted at different temperatures and/or wherein~~ 11 in which

the ~~sorption~~ adsorption and desorption steps are conducted at different pressures, ~~such that one or more of~~ wherein

(a) the total pressure of the desorption step is lower than the total pressure of the ~~sorption~~ adsorption step,

(b) the partial pressure of H_2S in the desorption step is less than the partial pressure of H_2S in the ~~sorption~~ adsorption step, ~~and~~ or

(c) ~~the pressure in the sorption step is such as to cause CO_2 to be sorbed from the gas stream in addition to the H_2S.~~ both (a) and (b).

14. A process according to claim 11 in which at least a portion of the sorbed H_2S is desorbed by a non-sorbing inert purge gas and/or by a displacement purge gas.

15. A cyclic process for separating H_2S and CO_2 from a natural gas feed stream comprising H_2S and CO_2, from a producing formation, which process comprises:

(i) contacting the natural gas feed stream under H_2S ~~sorption~~ adsorption conditions with a non-aqueous ~~sorbent~~ adsorbent comprising a basic non-protogenic ~~nitrogenous~~ tertiaryaminosiloxane compound grafted onto a mesoporous solid oxide having surface silanol groups selected from MCM-41, MCM-48, SBA-1, SBA-2, SBA-3, SBA-15, KIT-1, KIT-5, KIT-6, and combinations thereof wherein the non-aqueous adsorbent has a selectivity for H_2S over CO_2 under the H_2S adsorption conditions;

(ii) reacting at least a portion of the H_2S and CO_2 in the natural gas feed stream with the sorbent so that the H_2S and the CO_2 are ~~absorbed~~ adsorbed by the ~~sorbent~~ adsorbent;

(iii) retrieving a natural gas product stream having a lower mol% of each H_2S and CO_2 than the natural gas feed stream;

(iv) subjecting the ~~sorbent~~ adsorbent containing the ~~sorbed~~ adsorbed H_2S and CO_2 to first desorption conditions by which a higher mol% of CO_2 is desorbed than H_2S;

(v) retrieving a CO_2 rich product stream that has a higher mol% of CO_2 than the natural gas feed stream;

(vi) subjecting the ~~sorbent~~ adsorbent containing the ~~sorbed~~ adsorbed H_2S and CO_2 to second desorption conditions by which a higher mol% of H_2S is desorbed than CO_2;

(vii) retrieving an H_2S-rich product stream that has a higher mol% of H_2S than the natural gas feed stream; and

(viii) re-injecting the side stream comprising CO_2 into the producing formation.~~, wherein the natural gas product stream has a lower mol% of each H_2S and CO_2 than the natural gas feed stream.~~

16. A process according to claim 15 further comprising:

sending at least a portion of the H_2S-rich stream to a Claus plant; and recovering sulfur from the H_2S-rich stream.

17. A cyclic process for separating H_2S and CO_2 from a feed gas stream comprising H_2S and CO_2, to produce a first product gas stream comprising H_2S and a second product gas stream comprising CO_2 depleted in H_2S, which process comprises:

(i) contacting the feed gas stream under H_2S ~~sorption~~ adsorption conditions with a non-aqueous ~~sorbent~~ adsorbent comprising a basic non-protogenic ~~nitrogenous~~ tertiaryaminosiloxane compound grafted onto a mesoporous solid oxide having surface silanol groups selected from MCM-41, MCM-48, SBA-1, SBA-2, SBA-3, SBA-15, KIT-1, KIT-5, KIT-6, and combinations thereof wherein the non-aqueous adsorbent has a selectivity for H_2S over CO_2 under the H_2S adsorption conditions;

(ii) reacting at least a portion of the H_2S and the CO_2 in the feed gas stream with the ~~sorbent~~ adsorbent so that the H_2S and CO_2 are ~~absorbed~~ adsorbed by the ~~sorbent~~ adsorbent;

(iii) subjecting the ~~sorbent~~ adsorbent containing the ~~absorbed~~ adsorbed H_2S and CO_2 to CO_2 desorption conditions by which a higher mol% of the CO_2 is desorbed than H_2S;

(iv) retrieving a CO_2 rich product stream that has a higher mol% of CO_2 than the feed gas stream;

(v) subjecting the ~~sorbent~~ adsorbent containing the ~~absorbed~~ adsorbed H_2S and CO_2 to H_2S desorption conditions by which a higher mol% of H_2S is desorbed than CO_2; and

(vi) retrieving an H_2S rich product stream that has a higher mol% of H_2S than the feed gas stream.

18. A process according to claim 17 in which the CO_2 rich product stream has a lower mol% of H_2S than the feed gas stream. ~~and/or in which at least a portion of the H_2S-rich product stream is passed to a Claus plant for the recovery of sulfur.~~

19. A process according to claim 18 in which the feed gas stream comprises at least a combined total of 50 mol% H_2S and CO_2, wherein the feed gas stream is a pre-separated contaminant stream resulting from the separation of H_2S and CO_2 from a natural gas stream from a producing formation and the CO_2-rich stream is re-injected into the producing formation.

20. A process according to claim 17 in which at least a portion of the H_2S-rich product stream is passed to a Claus plant for the recovery of sulfur.