CLAIMS

1. A method of sequestering CO_2 comprising:

(a) in a first cathodic chamber, performing an alkaline process comprising:

(i) alkalinizing a first solution by contacting the first solution with a cathode disposed inside the cathodic chamber, thereby forming an alkaline solution and H_2, wherein the first solution comprises water and divalent alkaline earth ions;

(ii) contacting the alkaline solution with a CO_2 source, thereby forming a carbonated solution comprising a mixture of ionic compounds, wherein the ionic compounds comprise CO_3^{2-};

(b) in a first anodic chamber, performing an acidic process comprising:

(i) acidifying a second solution comprising chloride ions by contacting the second solution with an anode disposed inside the anodic chamber, thereby forming an acidic solution; and

(ii) deacidifying the acidic solution by contacting the acidic solution with a deacidifying agent, thereby forming a deacidified solution; and

(c) dechlorinating the acidic solution or deacidified solution by contacting the acidic solution or the deacidified solution with a dechlorinating agent;

wherein:

the cathodic chamber and the anodic chamber are in ionic communication; and

the acidic process and the alkaline process are performed simultaneously or sequentially.

2. The method of claim 1, wherein the first solution is selected from seawater, desalination brine, industrial brine, and natural brine.

3. The method of claim 1 or 2, wherein the second solution is selected from seawater, desalination brine, industrial brine, and natural brine.

4. The method of any one of claims 1-3, wherein the alkaline process and acidic process occur in spaces separated by a semi-permeable barrier.

5. The method of claim 4, wherein the semi-permeable barrier is a semi-permeable membrane.

6. The method of any one of claims 1-5, wherein the acidic solution has a pH from about 0.1 to about 7.

7. The method of claim 6, wherein the acidic solution has a pH from about 0.5 to 1.5.

8. The method of claim 7, wherein the acidic solution has a pH of about 1.

9. A system for the sequestration of CO_2 comprising:

(a) a cathodic chamber comprising:

a cathode

an cathodic gas outlet;

a first solution inlet; and

an alkaline solution outlet;

wherein the cathode is disposed inside the cathodic chamber and coupled to a power source; and

(b) an anodic chamber comprising:

an anode;

an anodic gas outlet;

a second solution inlet; and

an acidic solution outlet;

wherein the anode is disposed inside the anodic chamber and coupled to a power source;

wherein the cathodic chamber and the anodic chamber are in ionic communication.

10. The system of claim 9, further comprising a deacidification chamber comprising:

an acidic solution inlet;

a deacidified solution outlet;

a deacidifying agent;

wherein the deacidifying agent is disposed inside the deacidification chamber, and the acidic solution inlet of the deacidification chamber is coupled to the acidic solution outlet.

11. The system of claim 9 or 10, further comprising a dechlorination chamber comprising:

a chlorinated solution inlet;

a dechlorinated solution outlet;

a dechlorinating agent;

wherein the dechlorinating agent is disposed inside the dechlorination chamber, and the chlorinated solution inlet is coupled to the deacidified solution outlet, when present, or the acidic solution outlet.

12. A method of sequestering CO_2 comprising:

(a) in a first cathodic chamber, performing a first alkaline process comprising:

(i) alkalinizing a first solution by contacting the first solution with a cathode disposed within the first cathodic chamber, thereby forming an alkaline solution and producing H_2, wherein the first solution comprises water and divalent alkaline earth ions;

(ii) contacting the alkaline solution with a CO_2 source, thereby forming a carbonated solution comprising a mixture of salts comprising OH^- and/or CO_3^{2-};

(iii) precipitating the salts comprising OH^- and/or CO_3^{2-} from the carbonated solution;

(b) in a first anodic chamber, performing a first acidic process comprising:

(i) acidifying a second solution comprising chloride ions by contacting the second solution with an anode disposed within the first anodic chamber, thereby forming an acidic solution; and

(ii) deacidifying the acidic solution by contacting the acidic solution with a deacidifying agent, thereby forming a deacidified solution; and

(c) dechlorinating the acidic solution or deacidified solution by contacting the acidic solution or the deacidified solution with a dechlorinating agent;

wherein:

the first cathodic chamber and first anodic chamber are in ionic communication;

the first solution and second solution are aqueous solutions having greater than about 8 parts per thousand (ppt) total dissolved solids; and

the first acidic process and the first alkaline process are performed simultaneously or sequentially.

13. The method of claim 12, wherein the first solution and second solution each comprise Mg and Ca.

14. The method of claim 13, wherein the first solution and second solution further comprise Na.

15. The method of any one of claims 12-14, further comprising isolating the salts comprising OH^- and/or CO_3^{2-} from the carbonated solution.

16. The method of any one of claims 12-15, wherein the first solution and the second solution each comprise greater than about 10 parts per thousand (ppt) total dissolved solids, greater than about 15 ppt total dissolved solids, greater than about 20 ppt total dissolved solids, greater than about 25 ppt total dissolved solids, greater than about 30 ppt total dissolved solids, greater than about 35 ppt total dissolved solids, greater than about 40 ppt total dissolved solids, greater than about 55 ppt total dissolved solids, greater than about 70 ppt total dissolved solids, greater than about 85 ppt total dissolved solids, greater than about 100 ppt total dissolved solids, greater than about 150 ppt total dissolved solids, greater than about 200 ppt total dissolved solids, greater than about 225 ppt total dissolved solids, greater than about 250 ppt total dissolved solids, or greater than about 500 ppt total dissolved solids.

17. The method of any one of claims 1-8 and 12-16, wherein the first alkaline process and first acidic process are performed simultaneously.

18. The method of any one of claims 1-8 and 12-17, wherein the anode mitigates chlorine evolution reactions (ClER) to less than 25% Faraday efficiency at current densities of 0.001 to 100000 A/m^2.

19. The method of any one of claims 1-8 and 12-18, wherein the anode comprises a group 6, group 7, or group 8 element.

20. The method of claim 19, wherein the anode comprises a group 7 element.

21. The method of claim 20, wherein the group 7 element is manganese.

22. The method of claim 19, wherein the anode comprises manganese oxide.

23. The method of any one of claims 1-8 and 19-22, wherein the anode further comprises a transition metal additive.

24. The method of claim 19, wherein the anode comprises manganese oxide coated onto a transition metal substrate.

25. The method of claim 24, wherein the transition metal substrate comprises titanium.

26. The method of any one of claims 1-8 and 12-25, wherein the deacidifying agent is selected from an ion exchange resin, Periclase, Lime, Lime Kiln Dust, Forsterite, Olivine, Larnite, Serpentinite, Basalt, Stainless steel slag, Peridotite, Lizardite (Serpentine), Ladle slag, Blast furnace slag, Diopside, Air-cooled blast furnace slag, Wollastonite, Basic oxygen furnace slag, Brownmillerite, Comingled electric arc furnace slag, Cement kiln dust, Talc, Electric arc furnace slag, Class C fly ash, Reclaimed Class C fly ash, Anorthite, Trona-rich fly ash, Bytownite, Gabbro, Anorthosite, Albite, and Class F fly ash.

27. The method of claim 26, wherein the deacidifying agent is an ion exchange resin.

28. The method of any one of claims 1-8 and 12-27, wherein the dechlorinating agent is selected from Hydrogen sulfide, Sulfur dioxide, Sulfite salts, Copper slag, Fayalite, Ferrosilite, Magnetite, Antigotite, Periclase, Lime, Lime Kiln Dust, Forsterite, Olivine, Larnite, Serpentinite, Basalt, Stainless steel slag, Peridotite, Lizardite (Serpentine), Ladle slag, Blast furnace slag, Diopside, Air-cooled blast furnace slag, Wollastonite, Basic oxygen furnace slag, Brownmillerite, Comingled electric arc furnace slag, Cement kiln dust, Talc, Electric arc furnace slag, Class C fly ash, Reclaimed Class C fly ash, Anorthite, Trona-rich fly ash, Bytownite, Gabbro, Anorthosite, Albite, and Class F fly ash.

29. The method of any one of claims 1-8 and 12-28, wherein the deacidifying agent is the dechlorinating agent.

30. The method of any one of claims 1-8 and 12-29, wherein the CO_2 source comprises from about 400 ppm to about 100% CO_2, preferably about 400 ppm.

31. The method of any one of claims 1-8 and 12-30, wherein the CO_2 source is ambient air.

32. The method of any one of claims 1-8 and 12-30, wherein the CO_2 source has a higher CO_2 concentration than ambient air.

33. The method of any one of claims 12-32, wherein the first solution is an aqueous solution produced as a byproduct of oil and gas extraction.

34. The method of any one of claims 12-33, wherein the second solution is an aqueous solution produced as a byproduct of oil and gas extraction.

35. The method of any one of claims 1-8 and 12-34, wherein the first solution and the second solution are from the same source solution.

36. The method of any one of claims 12-35, wherein the first alkaline process and first acidic process occur in spaces separated by a semi-permeable barrier.

37. The method of claim 36, wherein the semi-permeable barrier is a semi-permeable membrane.

38. The method of any one of claims 1-8 and 12-37, wherein the alkaline solution has a pH from about 7 to about 14.

39. The method of claim 38, wherein the alkaline solution has a pH from about 10 to about 11.

40. The method of claim 39, wherein the alkaline solution has a pH of about 10.5.

41. The method of any one of claims 12-40, wherein the acidic solution has a pH from about 0.1 to about 7.

42. The method of claim 41, wherein the acidic solution has a pH from about 0.5 to 3.5.

43. The method of any one of claims 12-42, wherein the first acidic process and first alkaline process are performed at a pass conversion from about 5 to about 95.

44. The method of any one of claims 12-43, further comprising forming the first solution and second solution by separating sodium from a source solution.

45. The method of claim 44, wherein separating sodium from the first solution and second solution comprises nanofiltration or reverse osmosis.

46. The method of claim 45, wherein separating sodium from the source solution forms an aqueous permeate solution and an aqueous retentate solution, and the aqueous permeate solution is used for the first solution and the second solution.

47. The method of any one of claims 12-46, further comprising adding $Mg(OH)_2$ to the first solution before or during the first alkaline process.

48. The method of any one of claims 12-47, further comprising performing a second alkaline process in sequence with the first alkaline process.

49. The method of claim 48, wherein predominantly $Mg(OH)_2$ is produced in the first alkaline process.

50. The method of claim 49, wherein predominantly $Ca(OH)_2$ is produced in the second alkaline process.

51. The method of claim 50, wherein the $Mg(OH)_2$ produced in the first alkaline process and the $Ca(OH)_2$ produced in the second alkaline process are of a purity greater than 70% .

52. The method of any one of claims 49-51, further comprising separating chloride ions from the $Ca(OH)_2$ and the $Mg(OH)_2$ *in situ*.

53. The method of any one of claims 1-8 and 12-52, wherein the deacidifying agent comprises Mg, Fe, Si, and O.

54. The method of any one of claims 1-8 and 12-52, wherein the dechlorinating agent comprises Mg, Fe, Si, and O.