

CLAIMS:

1. A communication system for use in conjunction with a well having a metallic well structure therein, the system comprising:

a downhole apparatus configured to be positioned in an open-hole section within the well below the metallic well structure, the downhole apparatus being further configured to wirelessly transmit data signals from or through the open hole section, through surrounding formation, for receipt at the metallic well structure itself for propagation via that metallic well structure; and

at least one receiver configured to be deployed at a top of the well, and further configured to receive the data signals from the metallic well structure; and

~~2. The system according to claim 1, further comprising a~~ communications device configured to receive the wirelessly transmitted data signals from the downhole apparatus and to inject the data signals into the metallic well structure for propagation therethrough.

~~32.~~ The system according to claim ~~21~~, wherein the communications device is configured to be in contact with the metallic well structure for injecting the data signals into the metallic well structure.

~~43.~~ The system according to any of claim ~~21~~ or ~~32~~, wherein the communications device is configured to modulate the wirelessly received data signals for injection into the metallic well structure for reception by the at least one receiver.

54. The system according to any preceding claim, wherein the downhole apparatus is configured to wirelessly transmit the data signals up to 500 metres.

5 65. The system according to any preceding claim, wherein the well is an abandoned well comprising a first plug, the downhole apparatus being configured to be positioned below the first plug and to wirelessly transmit the data signal through the first plug.

10 70. The system according to claim 65 when dependent directly or indirectly on claim 21, wherein the abandoned well further comprises a second plug, and wherein the communications device is configured to be positioned above the first plug and below the second plug.

15 87. The system according to claim 65 or 70, wherein the metallic well structure is severed below a surface, and wherein the at least one receiver is configured to be deployed at a ground region in proximity to the well for receiving the data signals from the metallic well structure through the ground region.

20 90. The system according to claim 87, wherein the at least one receiver is configured to receive the data signals from the metallic well structure through roughly 1 to 20 metres of ground region.

25 409. The system according to claim 87 or 90, wherein the at least one receiver is configured to be fixed, or otherwise secured, to the ground region when deployed.

4110. The system according to any of claims 87 to 409, comprising a plurality of receivers arranged spatially at the ground region in proximity to the abandoned well.

4211. The system according to claim 4410, wherein the spacing between each of the receivers is at regular intervals.

5 4312. The system according to any claim 4410 or 4211, further comprising a processing unit configured to receive and process data signals from the plurality of receivers so as to perform data fusion of signals from different receivers in order provide a data signal representative of the data signal injected to the metallic well structure of the well.

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4413. The system according to claim 4312, wherein the processing unit is configured to correlate the data signals received from different receivers in order provide a data signal representative of the data injected to the metallic well structure of the well.

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4514. The system according to any of claims 4410 to 4413, wherein the plurality of receivers are configured to receive the data signals using at least two different receiving methods.

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4615. The system according to any of claims 4410 to 4514, wherein the plurality of receivers comprises a receiver including an electrode configured to receive data signals using a first receiving method, and/or a receiver including a loop antenna configured to receive data signals using a second receiving method.

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4716. The system according to claim 4615, wherein the processing unit is configured to process data from one or more of the receiving methods.

17. The system according to any preceding claim, wherein the at least one receiver is configured to be deployed in a body of water and is configured to be deployed at a seabed or mudline in proximity to the well.

5 18. The system according to any preceding claim, further comprising a transmitter configured to transmit data received by the receivers for subsequent receipt at a remote location.

10 19. The system according to any preceding claim, wherein the data signals are electromagnetic (EM) data signals.

20 20. The system according to claim 19, wherein the at least one receiver is configured to receive EM data signals having a frequency in the region of a range from 0.05 Hz to 10 Hz.

15 21. The system according to any preceding claim, wherein the downhole apparatus comprises a sensor configured to sense one or more of temperature and pressure within the well.

20 22. The system according to any preceding claim, wherein the well has a discontinuous metallic well structure that cannot act as a sole transmission medium from the downhole apparatus to the at least one receiver.

25 23. The system according to claim 22, wherein the discontinuous nature of the metallic well structure is represented by an end of the metallic well structure and the open-hole section.

2524. A method for determining whether there is connectivity between a plurality of subterranean reservoirs of hydrocarbon material, each reservoir intercepted by at least one of a plurality of appraisal and/or production wells, wherein at least one of the plurality of wells has a communication system according to any of claims 1 to 24-23 fitted therein, the method comprising:

altering a parameter in a first reservoir intercepted by a first well of the plurality of wells, wherein the altered parameter in the first reservoir is detectable by a downhole apparatus of the communications system fitted within a second well;

sensing a corresponding parameter in a second reservoir intercepted by the second well using the downhole apparatus of the communications system fitted within the second well for determining whether there is connectivity between the first and second reservoirs.

2625. The method according to claim 2524, wherein the altered parameter comprises pressure, and wherein the pressure in the first reservoir is altered by injection of a substance into the first well or removal of a substance from the first well.

2726. The method according to claim 2625, wherein altering the pressure in the first reservoir comprises injecting water into the first reservoir via the first well.

2827. The method according to any of claims 25-24 to 2726, wherein the second well is an abandoned well and optionally an abandoned appraisal well.

2928. The method according to any of claims 25-24 to 2827, wherein the second well comprises an open hole section that intercepts the second reservoir, and wherein the downhole apparatus is located in the open hole section.

3029. A method for deploying a system for monitoring abandonment of a well comprising a metallic well structure section and an open hole section, the method comprising:

5 positioning a downhole apparatus in the open hole section, wherein the downhole apparatus is configured to wirelessly transmit data signals from or through the open hole section, through surrounding formation, for receipt at the metallic well structure section itself for transmission via a metallic well structure of that metallic well structure section; and

10 deploying at least one receiver at a top of the well, the at least one receiver configured to receive the data signals from the metallic well structure; and

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~~31. The method according to claim 30, further comprising:~~

15 positioning a communications device in the metallic well structure section, wherein the communications device is configured to receive the wirelessly transmitted data signals from the downhole apparatus and to inject the data signals into the metallic well structure of the metallic well structure section for propagation therethrough.

20 ~~3230.~~ The method according to claim ~~3129~~, further comprising positioning a first plug above the downhole apparatus and optionally positioning a second plug above the communications device.

25 ~~3331.~~ A computer program product that when programmed into a suitable controller configures the controller to perform a method according to any of claims ~~25-24~~ to ~~2928~~.

~~3432.~~ A carrier medium comprising the computer program product of claim ~~3331~~.

3533. The carrier medium of claim 3432, wherein the carrier medium is a computer readable carrier medium.

5 3634. An abandoned well comprising a communications system according to any of claims 1 to 2423.

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