e full potential

resources

NATURAL HYDROGEN EXPLORATION

Prospectivity

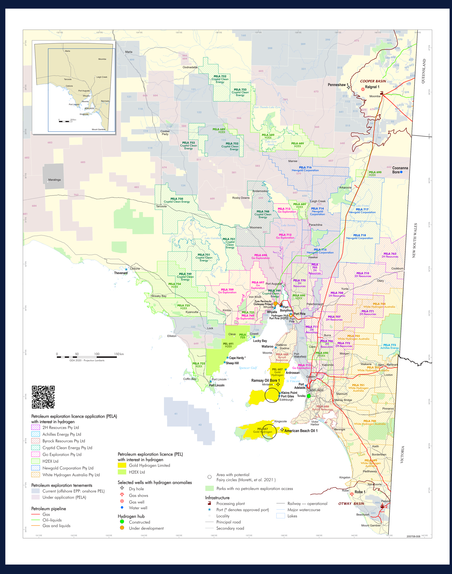
Why the interest in SA?

Since 2021 there have been over 40 applications for PELs targeting natural hydrogen across the state.

- Based on recently published papers (CSIRO, Geoscience Australia), significant potential exists for natural hydrogen plays in South Australia
- The interplay between the favourable geological conditions of hydrogen source, structure and sedimentary overburden and various South Australian geological terranes is summarised in the Hydrogen Prospectivity Summary Table.
- SA has a significant seriatim of prospective Archaean-Proterozoic basement provinces and Neoproterozoic to Cambrian basins which host substantial Fe^{2}-rich ultramafic, mafic, and bimodal volcanic and intrusive suites, komatiites, ironstones, iron ore and uranium resources. These provinces are structurally complex, hosting major crustal scale fault systems that may allow for deep hydrogen outgassing
- In addition, salt lakes on Yorke Peninsula and Kangaroo Island are postulated by international researchers to be "fairy circles" caused by surficial seepage of hydrogen gas fluxes (e.g. Moretti et al, 2021)

Direct evidence suggests:

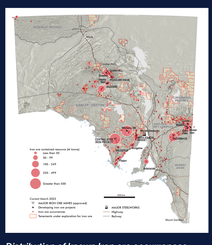
- Younger sedimentary basins in South Australia are prospective for native hydrogen with anomalous levels of native hydrogen gas measured in several boreholes:
  - Robe 1 |1915 Otway Basin|: 25.4% hydrogen recorded
  - American Beach Oil 1 |1921 Stansbury Basin|: 64 – 80% hydrogen recorded
  - Ramsay 1 Oil Bore |1931 Stansbury Basin|: 51.3 – 68.6% hydrogen recorded



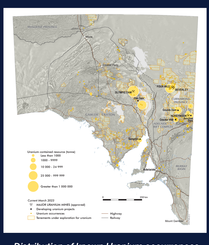
Hydrogen prospectivity summary

Hydrogen play elements	Province: Coompana	Musgrave	Gawler	Curnamona & Mt Painter inlier	Kanmantoo
Gabbros,mafics, untramafic intrusives					
Fe-rich granitoids/intrusives					
Uranium rich rocks			IOCGU		
Iron formations					
Ferruginous duricrusts					
Structural complexity/active faults					
Hydrogen shows					American Beach Oil bore 1

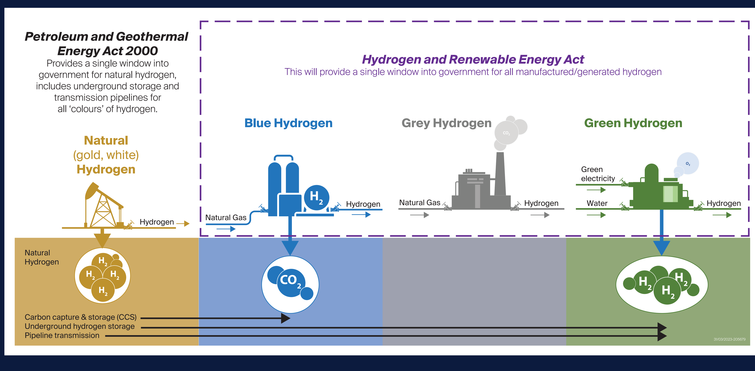
Hydrogen play elements	Basin: Adelaide Fold Belt/Stuart Shelf/Arrowie Basin	Officer Basin	Stansbury Basin	Eromanga Basin	Otway Basin
Mafic intrusives/extrusives					
Iron stones					
Salt/anhyhrite			?		
Deep Faults					
Hydrogen shows			Ramsay Oil syndicate Bore 1	Coonana 1, Ralgnal 1	Robe 1



Distribution of known Iron ore occurrences and resources.



Distribution of known Uranium occurrences and resources.



For more information on exploring for **NATURAL HYDROGEN:**

Geology

The discovery of natural hydrogen gas seeps and fluxes in a number of drillholes, including dedicated hydrogen production from the Bourakebougou field in Mali (Prinzhofer et al, 2018), has focussed attention on subsurface native hydrogen accumulations. Recent studies (e.g. Moretti et al, 2021; Zgonnik, 2020; Boreham et al, 2021) suggest that native hydrogen exists in a free gas state in a diversity of continental geological environments. Geological conditions favourable for native hydrogen exploration can include:

- Source rocks associated with basement complexes which contain Fe^{2+} and/or uranium rich rocks. These have potential for generating hydrogen via radiolytic and oxidation processes (e.g. Archaean greenstone and Precambrian basement terranes).
- Fractured and seismically active source areas - deep-seated faults can both channel migrating hydrogen from deep sources to surface and introduce water downward for further chemical reaction with exposed Fe^{2+} rich rocks.
- Sedimentary overburden may enable entrapment of migrating hydrogen particularly if aquifer systems and/or seals like evaporites are present. Evaporites (carnallite, sylvite) may also constitute a hydrogen source.
- Surficial hydrogen seeps. Seeps can be blind or coincident with visible sub-circular topographic depressions on the metre to kilometre scale ('fairy circles'), often associated with perturbed vegetation cover.
- It is early days for natural hydrogen exploration in Australia and globally. Upcoming company exploration activity in SA will test a diversity of natural hydrogen plays.

Regulation and licensing

On 11 February 2021 the Petroleum and Geothermal Energy Regulations 2013 were amended to declare hydrogen, hydrogen compounds and by-products from hydrogen production regulated substances under the Petroleum and Geothermal Energy Act 2000 (PGE Act). Companies are now able to apply to explore for natural hydrogen via a Petroleum Exploration Licence (PEL) and the transmission of hydrogen or compounds of hydrogen are now permissible under the transmission pipeline licencing provisions of the PGE Act.

Generation of green hydrogen will be covered by the Hydrogen and Renewable Energy Act. The consultation period closed on 10 February 2023, feedback will be reviewed and considered in shaping the provisions of the draft Act. A draft Bill is being prepared and will be and shared for public comment.

40 'over the counter' applications have been lodged for PELs targeting natural hydrogen since February 2021. The first PEL was granted in July 2021 to Gold Hydrogen Ltd. Their 5 year work program includes soil sampling, AEM-PTP, aeromagnetics and gravity surveying, seismic reprocessing and new acquisition, plus drilling one deep well.

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