Fig. 1: The Great Artesian Basin of Australia from Radke et al (2000). The basin is composed of several sub-basins that are both hydrologically and structurally identifiable. The recharge areas, the reconstructed 1880 potentiometric surface and the inferred flow directions are also shown.
Fig. 2: Regional drawdown (meters) of the potentiometric surface of the Cadna-owie-Hooray aquifer following development during the period 1880-1970 (from Habermehl, 1980)
Fig. 3: Recharge, natural spring discharge areas and directions of regional groundwater flow in the primary Cadna-owie-Hooray aquifer of the Great Artesian Basin based on 1980 data sources (from Habermehl, 1980). These inferred flowlines were used to guide the sampling locations for the 1982 and 1985 field work. Compare to Fig. 1.
Fig. 4: Chemical profiles along multiple flow lines within the Central Eromanga Basin of the eastern GAB. (a) Chloride, (b) sodium, (c) bicarbonate, (d) initial bicarbonate based on a $^{13}$C balance. The solid lines indicate 8-point moving averages of all wells except those in parentheses. The insert in part (a) shows the variation of rainfall for the region over the last 120kyrs. These data (from Airey et al., 1979) provided guidance for 1982 field work.
Fig. 5: Sampling locations and bores numbers for both the 1982 and the 1985 field work. Discussion of flow line evolution is typically discussed in terms of first and last sample (from Torgersen et al., 1992).
Fig. 6: Contours of deuterium isotopes (top) show a tongue of isotopically heavy water following the trends in flow directions seen in Fig. 3. Contours of $^{13}$C isotopes (bottom) reflect the trend in flow directions and the dominate geochemical dissolution of marine carbonates (from Airey et al., 1983)
Fig. 7: $^{36}\text{Cl}/\text{Cl}$ vs. $^{36}\text{Cl}$ concentration for the Great Artesian Basin (top) and the comparison of apparent $^{36}\text{Cl}$ tracer ages to apparent groundwater ages calculated from hydraulic properties (from Bentley et al., 1986)
Fig. 8: Helium concentrations vs. groundwater hydraulic age (as supported by $^{36}$Cl dates) for the Great Artesian Basin, Australia as deduced from the 1982 field work. For groundwaters younger than 40kyrs, the accumulation rate is $4.6 \times 10^{-12} \text{ccSTP}^4\text{He cm}^{-3} \text{H}_2\text{O yr}^{-1}$ which agrees with the calculated rate ($\lambda_{\text{He}}=1$) of $3.95 \times 10^{-12} \text{ccSTP}^4\text{He cm}^{-3} \text{H}_2\text{O yr}^{-1}$. For groundwaters greater than 100kyrs, the rate of accumulation is $2.91 \times 10^{-10} \text{ccSTP}^4\text{He cm}^{-3} \text{H}_2\text{O yr}^{-1}$ or 74x in situ production. An external bottom boundary flux provides the best explanation for the source and the timescale over which it can be seen (from Torgersen and Clarke, 1985).
Fig. 9: Mantle $^3$He is identified in portions of the two flow lines of the GAB, (Fairlight Trust to Wilfred Downs and Juanbong to Bonna Vista; left). The occurrence of Cenozoic volcanism (top left) and the groundwater flow lines (top right) show how this signal is carried into the interior of the GAB (from Torgersen et al., 1987)
Fig. 10: The evolution of dissolved $^{87}\text{Sr}/^{86}\text{Sr}$ within two flowlines of the GAB (north is Stannum to Innamincka and south is BonaVista to Thargomindah). The low $^{87}\text{Sr}/^{86}\text{Sr}$ ratio is acquired in the recharge zone likely via contact with Cenozoic volcanics (see Fig. 9 and note also the acquired $^3\text{He}$ signature). As the flowing groundwaters dissolve the host rock (0.7111) and marine carbonates (0.709234) in situ, that endmember is steadily acquired in the dissolved phase (after the measurements of Collerson et al. 1988).
Fig. 11: $^{36}$Cl measures along Fairlight Trust-to-Clayton flow line show a distinct discontinuity at Meerabooka possibly indicating flow line mixing as deduced by both the $^{36}$Cl/Cl vs. $^{36}$Cl plot (Bottom) and the apparent $^{36}$Cl age vs the apparent hydraulic groundwater age (Top) (from Torgersen et al 1991)
Fig. 12: Contours of $^4\text{He}$ in the Great Artesian Basin compiled from the 1982 and 1985 fieldwork. High $^4\text{He}$ concentrations clearly delineate the regions of oldest water within the southern Central Eromanga Basin (from Torgersen et al., 1992) and concur with the $^{36}\text{Cl}$ contours.
Fig. 13: Evolution of Na and K chemistry and TDS along the 1985 sampling lines as reported by Herczeg et al (1991). Note that the Western GAB (MtCrispe-to-Curdimurka) is distinct from the Eastern GAB and that mixing with the Eastern GAB flow is apparent at the end of the western flow line.
Fig. 14: Evolution of alkalinity, 13C, Ca+2 and Mg+2 chemistry along the 1985 sampling lines as reported by Herczeg et al (1991). Note that the Western GAB (MtCrispe-to-Curdimurka) is distinct from the Eastern GAB and that mixing with the Eastern GAB flow is apparent at the end of the western flow line.
Fig 15: Contours of $^{14}$C (in per cent modern) from Radke et al. (2000). The primary recharge areas are clearly delineated and the loss of $^{14}$C in the older regions of the GAB is clear.
Fig 16: Contours of $^{36}$Cl from Radke et al. (2000). The primary recharge areas are clearly delineated as is the locale for very old groundwater. The agreement with the age inferred from 4He contours (Fig. 12) is clear.
Fig. 17: Benchmark synthesis of flow rates and chemical evolution of the Great Artesian Basin (from Radke et al. 2000)
Fig. 18: Benchmark synthesis of the Great Artesian Basin showing flow rates, upward leakage and chemical evolution (increasing salinity; blue to orange) displayed over the basal structure of the Cadna-owie-Hooray aquifer (from Radke et al. 2000).