Table A4. Fuzzy analysis for IOCG prospectivity

Critical processes	*Appendix figure number*	*Input predictors map*	*Fuzzy-membership value map weight*	*Confidence factor*	*Rationale for expert-knowledge based weight (fuzzy membership values)*	*Rationale for confidence factor*
Polymetallic IOCG deposits are considered to be metasomatic expressions of large crustal-scale alteration events driven by intrusive activity. IOCG sensu stricto deposits are magmatic-hydrothermal deposits that contain economic Cu and Au grades, are structurally controlled, commonly contain significant volumes of breccia, are commonly associated with pre-sulfide sodic or sodic-calcic alteration, have alteration and/or brecciation zones on a large, commonly regional, scale relative to economic mineralization (Groves et al., 2010). Groves and Vielreicher (2001) suggested that most IOCG deposits (especially, the largest deposits in the class) are located close to a craton margin or other major lithospheric boundary, where decompression melting of metasomatised mantle produces volatile-rich alkaline magmas rich in REE, P, F and other incompatible elements, such as S, Cu and Au. These magmas have associated hydrothermal activity, which produces deposits with an element association compatible with their source, including variable combinations of Au, Co, Cu, F, Fe, LREE, Ni, Pt, Pd, P, Th and U. The IOCG deposits produced are commonly large pipe-like breccia bodies, with dimensions similar to diamondiferous kimberlite pipes that contain S-poor assemblages enriched in incompatible elements. They are commonly controlled by structural intersections in the vicinity of crustal-scale lineaments (Groves and Vielreicher 2001).						
Predictor maps for source						
IOCG deposits require volatile-charged magmas generated from metasomatized mantle lithosphere. Therefore, a potential source is indicated by rocks indicative of metasomatized mantle lithosphere (Skirrow and Walshe, 2002; Mathur et al., 2002).						
	A54	Distance to mafic rocks	9	8	Mafic magmas with primitive Nd isotope signatures are important sources of rare earth elements (REE) and Cu in the deposit (Johnson and McCulloch, 1995).	Mafic rocks were extracted using spatial query from GSWA (2010b). Mafic rocks include basalt, gabbro, troctolite, gabbronorite, dolerite and amphibolite. 1 km buffer
	A55	Distance to A-type (K-rich) granites with alkaline to subalkaline affinity (Groves et al., 2010),	9	8	A-type granites are considered critical, although in some cases the source may be distal from the deposit, as in the case of the Olympic Dam deposit. Consequently, a lack of surface expression of magmatism does not necessarily translate into unfavourability. IOCG deposits are genetically associated with, but can be spatially distinct from, large-scale magmatism that combines voluminous felsic magmatism with mafic and intermediate facies either within bimodal or more continuous series. For example, the A-type Hiltaba plutonic suite, coeval with Olympic Dam, is granitic to monzodioritic and related to the bimodal Gawler Range volcanic suite.	A-type (Pitjantjatjara + Warakurna) magmatic rocks were extracted using spatial query from GSWA (2010b). 500 m buffer
	A56	Distance to I-type (Na_2O rich) granites with alkaline to subalkaline affinity (Groves et al., 2010),	9	8	I-type granites are considered critical, though in some cases the source may be distal from the deposit, as in the case of the Bayan Obo deposit. Consequently, a lack of surface expression of magmatism does not necessarily translate into unfavourability. IOCG deposits are genetically associated with, but can be spatially distinct from large-scale magmatism that combines voluminous felsic magmatism with mafic and intermediate facies either within bimodal or more continuous series. For example, the A-type Hiltaba plutonic suite, coeval with Olympic Dam, is granitic to monzodioritic and related to the bimodal Gawler Range volcanic suite.	I-type (Wankanki) magmatic rocks were extracted using spatial query from the GSWA (2010b). 500 m buffer
Predictor maps for active pathways						
Large-scale crustal structures allow extensive hydrothermal circulation of mineralizing fluids						
	A4	Distance to crustal-scale fault	9	8.5	These crustal-scale faults were probably active during Giles events. Crustal scale faults are the most important as they drive most of the mineralized fluid (McCuaig et al., 2010; Joly et al., 2010)	Crustal-scale faults were extracted from the interpreted structural geology data and buffered to 10 km. They were identified by 2D gravity and magnetic modeling
	A57	Distance to early Giles (EG) + mid-Giles (MG)+ late Giles (LG) and post-Giles (PG) Event structures	9	9	Deep-penetrating structures provide pathways for metal transport or create suitable geometries for stress-driven fluid flow, and all known commodities are linked to this intraplate rifting event that tapped the mantle magma	Large-scale faults were extracted from the interpreted structural geology data and buffered to 5 km.
	A7	Distance to Petermann Orogeny (PO) + Alice Springs Orogeny (ASO) structures	8.5	9	These crustal-scale faults were active during Giles events. Mafic-ultramafic magmas need a plumbing system to reach upper levels of the crust, which can potentially follow trans-lithospheric faults (Hoatson et al., 2006). Long-lived structures are very good proxies for IOCG mineralization.	Large-scale faults were extracted from the interpreted structural geology data and buffered to 5 km.
	A8	Distance to Mount West Orogeny (MWO) + Musgrave Orogeny (MO) structures	8	9	Deep-penetrating structures provide pathways for metal transport or create suitable geometries for stress-driven fluid flow.	Large-scale faults were extracted from the interpreted structural geology data and buffered to 5 km.

Critical processes	*Appendix figure number*	*Input predictors map*	*Fuzzy-membership value map weight*	*Confidence factor*	*Rationale for expert-knowledge based weight (fuzzy membership values)*	*Rationale for confidence factor*
Predictor maps for physical traps						
Extensional and transtensional faults can channel hot deep-seated fluids upward and cold surface-waters downward, allowing for fluid mixing, large-scale alteration and mineralization. The depth at which fluid and metal recharge and discharge take place will influence the resulting structure, alteration and mineralization patterns as reviewed in Kerrich et al. (2000).						
	A41	Competency contrast across geological contact	7	7	Related to fracturing and opening up of spaces for fluid in-flow and ponding. This is not very important in IOCG, as these systems exploit exisitng architecture with volatile-charged magmas	Interpreted relative values from Grove's (1993) chart, not directly measured + interpreted bed rock geology
	A42	Geological contact density	7	8	More geological contacts means more lithological contrasts. Multilayer competency differences strongly influence fracture sizes and density distributions. Higher geological contact densities means that there is an increased probability of competency differences, and hence increased fault/fracture densities and dilation features.	Interpreted geology used (should be higher than both of the competency contrast maps)
	A43	Geological contact density weighted by competency contrast	9	7	See above - greater certainty regarding the existence of competency contrasts	Interpreted relative values from Grove's (1993) chart, not directly measured + interpreted mapped geology
	A11	Fault density	7.5	9	Conceptually should have a good correlation with mineralisation. Increased fault density implies greater structural complexity and more space, leading to fluid ponding.	All structures mapped well by geology and geophysics
	A12	Fault intersection	7.5	9	Good sites for fluid ponding	All structures mapped well by geology and geophysics
	A13	Fault intersection density	8	9	Indicate greater structural complexity; fluid focusing	All structures mapped well by geology and geophysics
	A10	Presence of circular feature (possible pipe-like breccia body)	9	6	IOCG deposits are commonly within large pipe-like breccia bodies (with radii varying from 700 m to 1400 m) that contain S-poor assemblages enriched in incompatible elements.	Mapped using Holden et al. (2010) porphyry detector (from circular in any rocks file porphyry700_1400RTP_CENTRES_t20). Radii values from 700 m to 1400 m were used to determine the size of chonolith to detect. A threshold value of 20 m determines which locations were retained, based on the strength of their radial symetry transform response.
	A58	Distance to regional seals	9	7	Regional seals inhibit the ascent of volatile-charged magmas or fluids. Local breaching of these will mark sites for potential IOCG mineralization. In the WMP, potential regionals seals are: 1) the extensive basaltic units of the Kunamarnara Group which pre-dates the Giles Complex, 2) the extensive bimodal volcanics in the Bentley Supergroup, which is synchronous with Alcurra Dolerite suite, and 3) the Wirku Metamorphics rocks, which include strongly banded gneiss and preserve a few non-faulted contacts.	Those lithotypes were queried out from the interpreted bedrock geological map in GSWA (2010b). CF low because not the whole selected layers are not necessary a physical trap (difference of lithology within units)
Predictor maps for chemical traps						
The host rocks for IOCG deposits are varied and do not constitute a diagnostic feature. They encompass coeval or pre-existing sedimentary rocks, mafic to felsic volcanic or plutonic rocks, schists and gneisses that have served as lithological ????? (e.g. due to competency contrast or permeability)						
	A46	Presence of Fe-rich rocks (magnetite presence in P_-WKg1-am unit) + hematite	8	8	Iron oxide–copper–gold (IOCG) deposits encompass a wide spectrum of sulphide-deficient, low-Ti magnetite and/or hematite ore bodies. In addition, these rocks could indicate that the concentration of mantle-derived S can be extremely efficient in some cases, or that S was added from an external source that had mantle-like S isotopic signatures (Maier and Groves, 2011).	Fe-rich units units were extracted using spatial query from GSWA (2010) + mineral occurrence database
	A9	Distance to dyke	8	6	Dolerite dykes could be magma conduits and thus host magmatic sulfide IOCG mineralization potential in the Musgrave Province.	Query from new interpreted magnetic datasets + GSWA dataset. 1 km buffer
	A59	Distance to skarn	8	6	The morphology of IOCG mineralization varies significantly and includes breccia zones, veins, and irregular bodies; stratiform, stratabound, or discordant deposits, and disseminations to massive lenses (skarns, mantos).	Skarn units from were extracted using spatial query from GSWA (2010). They are located in the basement (Wirku Metamorphics units). Buffer 1 km
	A27	Cu content	9	6	Positive Cu anomaly is a direct indicator of Cu presence	Cu values from the GSWA state geochemistry (GSWA, 2010a) and GA Ozchem (GA, 2007) datasets were transformed to standardized Z scores (Singer and Kouda, 2001) and interpolated. The Z scores at which studentized contrast maximized were used as the anomaly thresholds (see Cheng, 2007 for details). CF low because we have interpolated the data in the whole study and some values are not known.

Critical processes	*Appendix figure number*	*Input predictors map*	*Fuzzy-membership value map weight*	*Confidence factor*	*Rationale for expert-knowledge based weight (fuzzy membership values)*	*Rationale for confidence factor*
	A50	Au content	9	6	Positive Au anomaly is a direct indicator of Au presence	Au values from the GSWA state geochemistry (GSWA, 2010a) and GA Ozchem (GA, 2007) datasets were transformed to standardized Z scores (Singer and Kouda, 2001) and interpolated. The Z scores at which studentized contrast maximized were used as the anomaly thresholds (see Cheng, 2007 for details). CF low because we have interpolated the data in the whole study and some values are not known.
	A60	Ag/Zr ratio	8	6	On the basis of the stoichiometry of the major minerals constituting both fresh and altered host rocks, and using Zr (ppm) as a common denominator, various molar element ratios can be used to evaluate whether minerals undergoing mass transfer processes have collinear behaviour (i.e. Pearce element ratio (PER) diagrams; for details, see Stanley and Madeisky 1994). Positive Ag/Zr anomalies could be indicative of IOCG-type deposit	Ag and Zr values from the GSWA state geochemistry (GSWA, 2010a) and GA Ozchem (GA, 2007) datasets were transformed to standardized Z scores (Singer and Kouda, 2001) and interpolated. The Z scores at which studentized contrast maximized were used as the anomaly thresholds (see Cheng, 2007 for details). CF low because we have interpolated the data in the whole study and some values are not known.
	A61	U/Zr ratio	8	6	On the basis of the stoichiometry of the major minerals constituting both fresh and altered host rocks, and using Zr (ppm) as a common denominator, various molar element ratios can be used to evaluate whether minerals undergoing mass transfer processes have collinear behaviour (i.e. Pearce element ratio (PER) diagrams; for details, see Stanley and Madeisky 1994). Positive U/Zr anomalies could be indicative of IOCG-type deposit	U and Zr values from the GSWA state geochemistry (GSWA, 2010a) and GA Ozchem (GA, 2007) datasets were transformed to standardized Z scores (Singer and Kouda, 2001) and interpolated. The Z scores at which studentized contrast maximized were used as the anomaly thresholds (see Cheng, 2007 for details). CF low because we have interpolated the data in the whole study and some values are not known.
	A62	Bi/Zr ratio	8	6	On the basis of the stoichiometry of the major minerals constituting both fresh and altered host rocks, and using Zr (ppm) as a common denominator, various molar element ratios can be used to evaluate whether minerals undergoing mass transfer processes have collinear behaviour (i.e. Pearce element ratio (PER) diagrams; for details, see Stanley and Madeisky 1994). Positive Bi/Zr anomalies could be indicative of IOCG-type deposit	Bi and Zr values from the GSWA state geochemistry (GSWA, 2010a) and GA Ozchem (GA, 2007) datasets were transformed to standardized Z scores (Singer and Kouda, 2001) and interpolated. The Z scores at which studentized contrast maximized were used as the anomaly thresholds (see Cheng, 2007 for details). CF low because we have interpolated the data in the whole study and some values are not known.
Undefinable predictor maps						
		Non-magmatic brines (e.g. evaporitic fluid or basinal brines; Barton and Johnson 1996; Haynes, 2000)	8	8	Mixing of magmatic fluids with near surface meteoritic fluids or brines is commonly invoked in mineral system models. A role for evaporites as the source of NaCl in the mineralizing solutions to carry the metals and to generate regional-scale sodic alteration (Barton and Johnson, 1996) is also inferred. The presence of evaporite is, however, not an essential prerequisite for the formation of IOCG deposits (Nisbet et al., 2000) as many have magmatic fluid signatures (e.g. Marshall, 2003).	Not mapped in the area
		Alkaline-carbonatite stocks	9	8	Very reactive fluids associated with short-lived magmatism such as carbonatite stocks (e.g. Mark et al., 2000). Alkaline rocks are indicative of metasomatized mantle lithosphere (e.g. Skirrow, 1999; Mathur et al., 2002).	No alkaline rocks (lamprophyres, lamproites, kimberlites, syenites, carbonatites, phonolite.) in the area
		Hydrothermal breccia/stockworks	8	8	The Olympic Dam deposit is hosted within a 7 x 5 km (in plan), funnel-shaped, hematite-rich hydrothermal breccia (Reeve et al., 1990).	One tourmaline breccia has been described in Mt Eveline geological map, and tiny breccia faults were located into but this is not enough to make a whole predictor map,