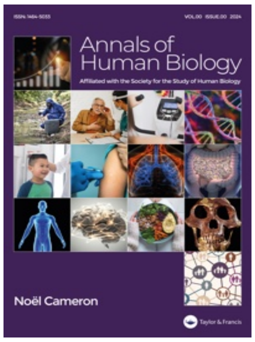

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RESEARCH PAPER

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Catalogue of immature hominin fossils from the University of the Witwatersrand, South Africa

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ABSTRACT

Background: This study evaluates the fossil remains of South African hominins curated at the University of Witwatersrand Johannesburg (Wits University), the largest repository of human evolution assemblages in southern Africa.

Aim: The aim of the study was to identify immature specimens within the assemblage as a resource for paleoanthropologists in understanding developmental adaptations in Plio-Pleistocene hominins.

Subjects and methods: Data were compiled from curatorial catalogues, visual inspections, unpublished notes, and published site-specific inventories. The assessment classified specimens as "Pre-Adult" based on dental, cranial, and postcranial maturity indicators, following established methodologies.

Results: Of the 3,277 catalogued specimens in the Wits hominin collections, 650 entries (19.8%) were identified as immature, representing three genera: *Australopithecus*, *Paranthropus*, and *Homo*. These findings were analysed by site, element type, and specimen associations. Notable insights include pre-adult remains of *Australopithecus* from Malapa, Sterkfontein and Makapansgat, *Paranthropus* from Drimolen and Kromdraai, and *Homo* from Rising Star. The variability in accessioning practices, fragmentary preservation, and ongoing research influenced the completeness of the inventory, highlighting challenges in catalogue standardisation and fossil classification.

Conclusions: This comprehensive catalogue of immature fossils provides a critical resource for investigating morphological variation, life history traits, and evolutionary adaptations across hominin genera. It underscores the significance of South African fossil collections in exploring developmental patterns and evolutionary pathways leading to the extended life cycle characteristic of *Homo sapiens*.

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Immature; hominin; catalogue; South Africa; inventory

Introduction

The perception that immature individuals may not fully express the species morphology has undoubtably influenced paleoanthropology's focus on adult fossils, tracing back to the original debates of the Taung Child's designation as a hominin (Dart 1925; Keith 1925; Elliot Smith 1925; Woodward 1925; Duckworth 1925). With the increased recovery of immature hominin remains, research has broadened to include pre-adult morphologies and adaptations, recognising the value that they contribute to the interpretation of an extinct species (e.g. Leakey et al. 1964; Wolpoff 1979; Brown et al. 1985; Walker and Leakey 1993; Smith BH 1993; Clegg and Aiello 1999; Smith S 2004; Zihlman et al. 2004; Alemseged et al. 2006; Lordkipanidze et al. 2007; Ruff 2007; Dean and Smith BH 2009; Berger et al. 2010; Graves et al. 2010; Arsuaga et al. 2014; Berger et al. 2015; TM Smith et al. 2015; Hawks et al. 2017; Rosas et al. 2017; Cameron et al. 2017; de Ruiter et al. 2018; Herries et al. 2020; Braga et al. 2022, 2023; Braga and Grine 2024; Gunz et al. 2020; Cazenave et al. 2020; Bolter and Cameron 2020; Bermúdez-de-Castro et al. 2021; Saers et al. 2022; Carretero et al. 2024; García-González et al. 2024).

Humans have extended the overall length of immaturity while shortening weaning time and interbirth interval compared to the closely related African apes (cf. Harvey and Clutton-Brock 1985; Barrickman et al. 2008; Humphrey 2010). Paleoanthropologists investigate signatures in the fossil record that illuminate when shifts in life history may have occurred, formulating hypotheses to posit their adaptive potential during human evolution. The pressures shaping these life history variations may include the challenges of unpredictable ecological resources, the development of complex socio-behavioural skills, the evolution of energetic-demanding somatic systems, among other factors (e.g. Smith and Tompkins 1995; Bogin and Smith 1996; Leigh and Park 1998; Leigh 2001; Hawkes and Paine 2006; Walker, Burger, et al. 2006a; Walker, Hill, et al. 2006b; Robson and Wood 2008; Dean and Smith 2009; Schwartz 2012; Lee 2012; Ponce de León et al. 2016; Rosas et al. 2017; Miller et al. 2019; Nava et al. 2020). Determining the contribution of factors that have shaped the human life history profile benefits from

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comparison with closely related hominin species across the life span. This approach requires a source that characterises research collections by pre-adult status to identify the data available for comparative studies (Bolter et al. 2023). This paper represents one South African contribution to a maturity-assessed database for hominins.

South Africa's early hominin fossil record and Plio-Pleistocene sites are extensive. At least 13 sites cluster at the UNESCO World Heritage Site's *Cradle of Humankind*–Bolt's Farm Cave System, Cooper's Cave, Drimolen, Gladysvale, Gondolin, Haasgat, Kromdraai, Malapa, Minnaar's Cave, Plover's Lake, Rising Star, Sterkfontein and Swartkrans (Figure 1) (e.g. Broom 1938; Berger and Tobias 1994; Clarke 1998; Keyser et al. 2000; Brain 2004; de Ruiter et al. 2008; Steininger et al. 2008; Berger et al. 2010; Reynolds and Kibii 2011; Berger et al. 2015; Braga and Thackeray 2016). Outside this region, early hominin sites include Makapansgat (north of the Cradle) and the recovery of one individual at Taung (southwest of the Cradle) (e.g. Dart 1925). More recent species (*Homo heidelbergensis/rhodesiensis* and *Homo sapiens*) are found at Border Cave, Elandsfontein, Florisbad and Klasies River (see Thackeray 2016 for a full review).

The majority of fossils excavated from these sites are housed at the University of Witwatersrand (Wits) Philip V. Tobias (PVT) Fossil Primate and Hominid Laboratory, under the management of the University's Evolutionary Studies Institute (ESI), on the East Campus in Braamfontein, Johannesburg. All hominin fossils are heritage resources that are governed by national laws, specifically The National Heritage Resources Act, No. 25 of 1999 and are part of the national estate (Black et al. 2025). Permits to excavate for fossils are granted by the South African Heritage Resources Agency (SAHRA) to researchers with the support of the relevant accredited curating institution. After recovery of the fossils from the field, they are typically catalogued and housed at the curating institution. According to the University regulations, a moratorium will be placed on unpublished material for three years after discovery, plus one year for publication to allow the primary investigators and collaborators to publish. A further three years may be applied for, through the Curator and the Access Advisory Panel, should this be required. After this period, the material may be made available for study by other researchers. Applying this rule is not always practically possible, but is implemented in principle. Researchers must apply for permission to study specific fossils for a defined project. The formal request for access is submitted to the Wits University Collections Curator, who then forwards the application for review and approval by the University Fossil Access Advisory Panel.

The Wits Catalogue used for this project encompasses the hominin specimens from extinct species in the PVT Fossil Primate and Hominid Laboratory available as of December 2024. This study inventories this collection by maturity status.

Materials and methods

The assessment of the fossil material compiles data from the curatorial catalogue, in-person visual inspection, unpublished collection notes, and published site-specific inventories (see Table 1).

Materials

Hominin assemblage inventories are provided by the excavating permit holder when the materials are deposited at Wits University and often include descriptors of the specimen and genus identification. Extracted from these site inventories, the Wits Accessions Catalogue contains the following headings: Specimen Number; Alternative Identifier; Storage Location; Materials & Associations; Identification, Collection & Comments; and Notes. For this study, Table 2 captures the

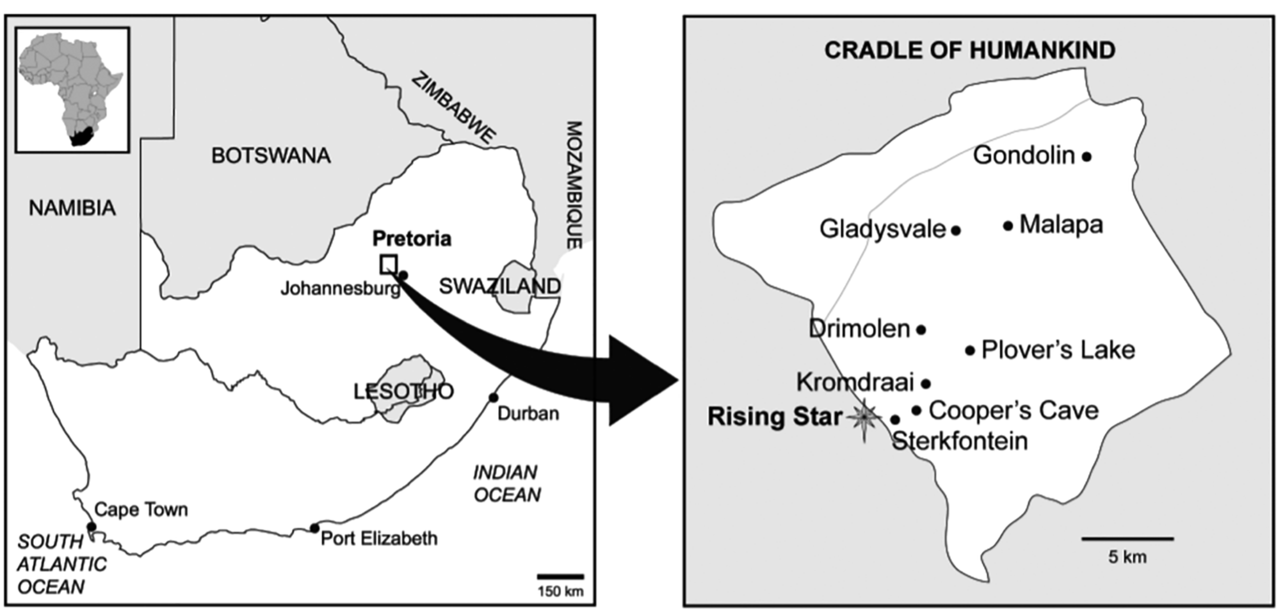

Figure 1. Left: Map showing location of South Africa, with Cradle of Humankind noted in dark bordered square. Right: Pull-out of Cradle of Humankind with hominin sites (not all included). Rising Star is emphasised, denoting the most recently discovered site (2013) in this region. From Kruger et al. (2016).

Table 1. Primary references sourced for this study, which include site inventories and descriptions of immature materials that complement the Wits Catalogue.

Drimolin (DNH)	Keyser et al. 2000; Moggi-Cecchi et al. 2010; Gallagher and Menter 2011; Herries et al. 2020; Martin et al. 2020; Leece et al. 2022; Leece et al. 2023.
Gondolin (GDA)	Menter et al. 1999
Kromdraai (KW)	Braga et al. 2017, 2022, 2023; Braga and Grine 2024
Makapansgat (MLD)	Dart 1948, 1962
Sterkfontein (StW)	Mann 1975; Grine 1984; Grine 1985; Moggi-Cecchi et al. 1998; Mentor 2002; Schwartz and Tattersall 2005; Moggi-Cecchi et al. 2006; Tawane et al. 2016; Pickering et al. 2019; Haeusler and Ruff 2020; DeSilva and Grabowski 2020; Jashashvili et al. 2020; Green 2020; Carlson et al. 2020; Drapeau and Menter 2020; Lague and Menter 2020; Kivell et al. 2020; Ward, Haeusler, et al. 2020; Ward, Rosenman, et al. 2020; Pickering et al. 2021
Swartkrans (SK, SKW)	Grine 1989; Grine and Daegling 1993; de Ruiter 2001; Grine 2004; de Ruiter et al. 2006; Skinner et al. 2024
Taung	Dart 1925
U.W. 88, Malapa (MH)	Berger et al. 2010, Berger 2013; Zipfel et al. 2011; de Ruiter et al. 2013; Cameron et al. 2017
U.W.101, Dinaledi Chamber, Rising Star	Berger et al. 2015; Kivell et al. 2015; Laird et al. 2017; Harcourt-Smith et al. 2015; Hawks et al. 2017; Marchi et al. 2017; Feuerriegel et al. 2017; Williams et al. 2017; VanSickle et al. 2018; Bailey et al. 2019; Bolter et al. 2020; Delezene et al. 2023; Berger et al. 2023
U.W.102, Lesedi Chamber, Rising Star	Hawks et al. 2017; Cofran et al. 2022
U.W.110, Rising Star (previously U.W.101)	Brophy et al. 2021

Note that this compilation is not intended as a reference bibliography of all publications that incorporate immature South African hominins over the last century.

Specimen Number, Materials & Associations, and Genus. When the genus is noted in the Wits Catalogue, it is included in Table 2. In the case where *Australopithecus robustus* was identified, this was converted to *Paranthropus*. Only extinct genera are included in this compilation; *Homo sapiens* remains are not assessed and itemised.

No independent assessment of genus was made for this study, and in some instances, published descriptions assign genus designations that were not previously in the Wits Catalogue. Those studies are referenced in Table 1. Note that Table 1 includes citations where immature material has been described and/or catalogued. The reference list does not serve as a comprehensive bibliography for each site, all descriptions or for all immature specimens, which is beyond the scope of this project.

Hominin designation was based on information provided in the Wits Catalogue. In a few instances, specimens have been reclassified as non-hominin in the Wits Accessions Catalogue after initial assessment as hominin. These non-hominin specimens have been removed from Table 2 and this analysis.

Collections may be housed in the PVT Fossil Laboratory but are still under the exclusive study of the permit holder of the site, and are not yet included in the Wits Catalogue or do not have published descriptions. These specimens are not included in this immaturity catalogue.

Methods

An adult individual has completed dental growth with permanent teeth erupted and in full occlusion. Dentition is classified as Pre-Adult if the teeth are deciduous. In the case of permanent dentition, a specimen is classified as Pre-Adult if one of the following characterises the tooth: (a) has partially erupted; (b) is crown complete but lacks roots; (c) has open roots; (d) lacks (or has a faint) interproximal contact facet (ICF); (e) has unworn, slightly or lightly worn crowns (after Molnar 1971; Moggi-Cecchi et al. 2006). In instances where these characteristics are ambiguous due to the state of fossil preservation and/or completeness, the teeth are assessed as indeterminate and not included in this maturity catalogue. Dental methods after Molnar (1971), Wolpoff (1979), Moggi-Cecchi et al. (2006), and Bolter et al. (2018). We recognise that dental wear methods are applied across genera with varying diets, which may overestimate maturity for more heavily worn teeth in older immature individuals with more abrasive diets. For example, earlier erupting teeth like M1 may be Pre-Adult but are moderately worn (e.g. SKW 5 Pre-Adult mandible with M3s only partially erupted). Thus, when isolated permanent teeth that erupt earlier in sequence are assessed, the maturity status may be overestimated.

An adult individual has completed skeletal growth, and all postcranial bones are fused. Postcranial remains are classified as Pre-Adult if (a) there are metaphyseal surfaces visible at the growth plates; or (b) the fusion of the epiphysis to diaphysis has not yet completed; or (c) the size of the bone is diminutive, indictive of immature status. Since the proximal and distal epiphyses in the same long bone fuse at different times across catarrhines (e.g. Schultz 1940; Washburn 1943; Shigehara 1980; Bolter and Zihlman 2012), the maturity status of an incomplete or fragmentary long bone (e.g. proximal radius) may be overestimated if only one epiphyseal region is available for assessment. In instances where the bone's maturity status is ambiguous due to poor fossil preservation, it is assessed as indeterminate and not included in this maturity catalogue.

Cranial remains are considered Pre-Adult if the bone is thin and single-layered (after Brophy et al. 2021). In some instances, immature designation is taken from comparative studies (e.g. Drimolen DNH 34: Keyser et al. 2000). Because ectocranial sutures may remain open in hominin crania into adulthood (e.g. Makapansgat MLD 37/38: Dart 1962; Ruengdit et al. 2020), open suture status does not singly assess as a Pre-Adult feature. In instances where the cranial bone's maturity status is ambiguous due to its fragmentary nature, the specimen is assessed as indeterminate and not included in this maturity catalogue.

In those instances where there are associated dental and post-cranial remains, the individual will be classified as Pre-Adult if any of the criteria above are met for non-adult status (e.g. MH1: Berger et al. 2010).

In some instances, Pre-Adult status has been determined through comparative studies, the references for which are listed in Table 1. However, the reference compilation in Table 1 does not serve as a comprehensive bibliography for each fossil specimen or site.

Table 2. Pre-adult catalogue for Wits University hominins.

Specimen no	Material and associations	Identification
CD 1634	Maxillary Ldm2	*Paranthropus*
CD 1638	Mandibular Ldm1	*Paranthropus*
CD 5774	Maxillary RM2	*Paranthropus*
CD 22619	Maxillary Ldm1	*Paranthropus*
DNH 2	Mandibular Ldm2	*Paranthropus*
DNH 12	R Mndb frag + M3 (2 pieces + frag)	*Paranthropus*
DNH 22	R Max frags + P4, (M1 root) M2, M3, R petrous, calvaria frags	*Paranthropus*
DNH 23	Maxillary Ldc	*Paranthropus?*
DNH 24	Maxillary Rdi2	*Homo?*
DNH 26	Mandibular RP4	*Paranthropus*
DNH 30	Maxillary Ldm2	*Paranthropus*
DNH 31	Maxillary Ldi2	*Paranthropus*
DNH 34	R petrous + basioccipital	*Homo*
DNH 35	R hemi-mandible, Rdm1-2 in mand. frag, RM1 (crown), Ldm2, R radius, ulna, vert body, frags	*Homo*
DNH 36	Maxillary Rdm1	*Paranthropus*
DNH 39	Maxillary RM1	*Homo*
DNH 42	Maxillary Rdm2 (frag)	*Homo?*
DNH 44	R mndb + dc,dm1-2,(M1) (a); R uln (b), dist rad (c)	*Paranthropus*
DNH 45	Maxillary RI2	*Homo*
DNH 46	R mndb body + dm2, M1-2 (3 pieces)	*Paranthropus*
DNH 47 a-j	Maxilla fragments Ldm1+ dm2; di1,dc, M1 (bud); R maxilla dm1, I1 (bud) (labelled DNH 69), Mandibular Rdm1(was DNH 45), dm2; frontal + part orbits	*Paranthropus*
DNH 48	Phalanx	
DNH 49	Mandibular Ldc	*Paranthropus*
DNH 50	R humerus	
DNH 56a,b	Mandibular Ldm2 and Rdm2, antimeres	*Paranthropus*
DNH 57a,b	Maxillary Ldm2 and RM1(crown), associated	*Paranthropus*
DNH 60 (2 trays)	Cranial frags (inc. larger pieces of L temp, R petrous, skull base), associated teeth: Maxillary Rdm1, LM1; Mandibular Rdm1, Rdm2, RM1, RM2 (bud)	*Paranthropus*
DNH 62	Maxillary LM1 (crown)	*Homo*
DNH 64	Ldm2 lower	
DNH 67	Mandibular RM1 (crown)	*Homo?*
DNH 68	R mndb frags + C,P3-4,M1-3; Another box labelled DNH 68 is mandibular Ldm2. Is not the same as C-M3 individual.	*Paranthropus*
DNH 69	RI1 (bud) upper	
DNH 70	Maxillary LM1 (crown), associates with DNH 71	*Homo*
DNH 71	Maxillary RI1 (bud), associates with DNH 70	*Homo*
DNH 72	Maxillary LC	
DNH 75	Mandibular RM3	*Paranthropus*
DNH 78	Mandibular RP3	*Paranthropus*
DNH 79	Mandibular LC and RC, antimeres	*Paranthropus*
DNH 81	Mandibular RM1 (crown)	*Paranthropus*
DNH 82	Maxillary RC	*Paranthropus*
DNH 83	Fragmentary maxilla; second frag with dm1 and broken pieces of dm2 (two different individuals)	
DNH 84	Fragmentary maxilla L with dm1 and 1/2 dm2; LM1 (crown), I1; Maxillary R I1, dm1	
DNH 85	Ldm2?	
DNH 87	Ld^c	*Paranthropus*
DNH 88	Ldi_1	*Paranthropus?*
DNH 89	Rdm^1	*Paranthropus*
DNH 90	DNH 90 LC	*Paranthropus*
DNH 91	DNH 91 LC	*Paranthropus?*
DNH 92	LP_3	
DNH 94	Ldi^1	*Paranthropus*
DNH 95	Rdi^2	*hominin?*
DNH 96	L and R dm^1	*Paranthropus*
DNH 99	Maxillary RM1 and LM1, antemeres	*Homo?*
DNH 100	Maxillary LM2	*Homo*
DNH 101	Mandibular RM2	*Paranthropus*
DNH 102	Mandibular LI2 and LC	*Homo*
DNH 103	I1?	
DNH 105	Molar fragment	
DNH 106	Maxillary fragment with LP4; LP3, LM1, LM2	*Paranthropus*
DNH 107 a-q	15 isolated mandibular teeth + 1 root frag	*Paranthropus*
DNH 108 a-j	Two maxillary fragments with dentition + 8 isolated teeth	*Paranthropus*
DNH 109	Near proximal right unla	
DNH 118	Manual intermediate phalanx	
DNH 121	Maxillary Ldm2	*Paranthropus*
DNH 125	Mandibular Ldm1	*Homo*
DNH 126	Maxillary molar crown fragment	*Paranthropus*
DNH 132	Maxillary Rdm2 (frag)	*Homo*
DNH 133	Maxillary RP4 crown	*Paranthropus*
DNH 134	Partial cranium	*Homo*
DNH 136	Maxillary dm1	*Paranthropus*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
DNH 146	Maxillary Rdm2	*Paranthropus*
DNH 148	Maxillary RM2 crown	*Paranthropus*
GVH 1	Premolar	
GVH 2	Molar	
GVH 5	Deciduous molar	
KW 6087	Craniodental remains	*Homo*
KW 6420	Partial mandible with Rdm1-2, Ldm1 (roots only)	*Paranthropus*
KW 6581	Mandibular deciduous canine, right	*Paranthropus*
KW 6584	Maxillary deciduous canine, left	*Paranthropus*
KW 6790	Mandibular M1, right	*Paranthropus*
KW 7000	Craniodental remains	*Homo*
KW 7010	Mandibular M1, right	*Paranthropus*
KW 7601	Mandibular P3, left	*Paranthropus*
KW 9000	Left maxilla with di1-dm2 and right maxilla with dc-dm2, isolated i1, i2	*Paranthropus*
KW 9600	Partial cranium consisting of 19 fragments	*Paranthropus*
KW 9610	Mandibular corpus fragment, right with isolated crowns RM1, LM1 and maxillary crowns RM1 and LM1	*Paranthropus*
KW 9623	Mandibular I1, right crown	*Paranthropus*
KW 9700	Left petrosal fragment	*Paranthropus*
KW 10100	Left exoccipital and occipital squama	*Paranthropus*
KW 10120	Mandibular dm2, right	*Paranthropus*
KW 10150	Left maxilla fragment with C1 and I1 crowns, and isolated M1 crown	*Paranthropus*
KW 10160	Isolated teeth: maxillary crowns, left I2, M1 and RM1, mandibular LM1	*Paranthropus*
KW 10840	Multiple cranial fragments including left maxilla; left and right temporals; left occipital, cranial base and vault; left I1, C, P3, M1 germs	*Paranthropus*
KW 10844	Mandibular P3 and P4 crowns, and right molar (M1 or M2) crown	*Paranthropus*
KW 10845	Maxillary I1 crown, right	*Paranthropus*
MLD 2	Mandible with dentition (associated with MLD 7, MLD 8)	
MLD 3	Cranial fragment	
MLD 5	Lower dm2	*Australopithecus*
MLD 7	Ilium, left (associated with MLD 2, MLD 8)	*Australopithecus*
MLD 8	Pelvis (?R ischium) (associated with MLD 2, MLD 7)	*Australopithecus*
MLD 11/30	Maxillary teeth (4) and Maxilla fragment with m1	*Australopithecus*
MLD 25	L Ilium	*Australopithecus*
MLD 30	R palate frag with m1 and p2 unerupted	*Australopithecus*
MLD 43	Maxillary central incisor	*Australopithecus*
SKW 5	Mandible RP3-M3; LP3-M3 with frags	
SKW 11	Partial cranium and maxilla with posterior dentition	
SKW 18	Partial cranium (base), edentulous	
SKW 33	Maxillary frag with RM1 (root) and M2	
SKW 34?	Isolated tooth frag	
SKW 3114	Isolated molar frags, maxillary LM1 and LM2	
SKW 4767	Isolated tooth, mandibular RM1	
SKW 4768	Isolated molar frags, maxillary LM2	
SKW 4772	Isolated tooth, maxillary RP4	
SKX 162	Maxilla, R with C, P3, P4 (probable association with SKX 308)	*Paranthropus*
SKX 163	Isolated tooth, maxillary Rdm2 mesial half	*Paranthropus*
SKX 268	Isolated tooth, maxillary RM1 (casts only)	*Homo*
SKX 269	Isolated tooth, RC (tooth in multiple fragments)	*Paranthropus*
SKX 308	Isolated tooth, RI2 (probable association with SKX 162)	
SKX 1437a, b	Isolated teeth frags, Maxillary LP4	*Paranthropus*
SKX 1756	Isolated tooth, maxillary dm1, partial	
SKX 2003	Isolated tooth, Maxillary Rdi1	*Paranthropus*
SKX 2354	Isolated tooth, mandibular LI2 germ	*Homo*
SKX 2355	Isolated tooth, mandibular LI1 germ	*Homo*
SKX 2356	Isolated tooth, possibly mandibular C or I2 germ	
SKX 4446	Mandible, right with P4-M2	*Paranthropus*
SKX 5004b	Isolated tooth, mandibular LI1	*Paranthropus*
SKX 5014	Isolated tooth, mandibular RM3	*Paranthropus*
SKX 10642	Isolated tooth, mandibular LM3	*Paranthropus*
SKX 10643	Isolated tooth, mandibular RM3	*Paranthropus*
SKX 10645	Isolated tooth, mandibular LM2, partial	*Paranthropus*
SKX 12538	Isolated tooth, maxillary LC germ	
SKX 14111	Maxillary left canine, partial crown	
SKX 16060	Isolated tooth, maxillary Rdi1	*Paranthropus*
SKX 25296	Isolated tooth, Maxillary L (or R?) C	*Paranthropus*
SKX 26625	Isolated tooth, maxillary LP4	*Paranthropus*
SKX 27151	Isolated tooth, mandibular Ldm2, buccal half	*Paranthropus*
SKX 28724	Isolated tooth, maxillary RC	*Paranthropus*
SKX 32162	Isolated tooth, mandibular RP4 crown	*Paranthropus*
SKX 32832	Isolated tooth, maxillary Rdm2	*Paranthropus*
SKX 37321	Isolated tooth, maxillary Rdi1	
SKX 41692/3	Vertebra, 2 pieces	
SKX 50081	Isolated tooth, mandibular Rdm2	
StW 6	Maxillary LM3	*Australopithecus*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
StW 21	Mandibular LC	
StW 42	Maxillary RI2	
StW 44	Mandibular LC	
StW 48	Mandibular RM2 (Major part to which this spm belongs is in Transvaal Museum)	
StW 50	Maxillary LP4	
StW 59	Right maxilla with teeth	*Australopithecus*
StW 61	Mandibular RM2	
StW 62	Maxillary deciduous LI1	*Australopithecus*
StW 67	Mandibular deciduous molars	*Australopithecus*
StW 73	Palate	*Australopithecus*
StW 74	Vertebrae (associated with StW 30)	*hominin?*
StW 75	Maxillary LP3; Isolated associated maxillary teeth	
StW 76	Maxillary LC; Associated with StW 75	
StW 77	Maxillary LI2; Associated with StW 75	
StW 78	Maxillary LI1; Associated with StW 75	
StW 79	Maxillary LI1; Associated with StW 75	
StW 84	Mandibular fragment with LM3 crown	
StW 90	Mandibular RM3	
StW 92	Maxillary LM3	
StW 96	Mandibular LM3	
StW 97	Mandibular Ldm2; probably associated with StW 246	
StW 103	Maxillary Rdm2	
StW 104	Mandibular corpus, left with LC, Ldm1-dm2	
StW 105	Radius, right prox and shaft frag	
StW 106	Mandibular RM1	
StW 107	Maxillary RI1	
StW 112	Mandibular LP4	
StW 116	Mandibular LI2; Associated with StW 117, 118, 119; probably associated with StW 120	
StW 117	Mandibular RI2; Part of StW 116 (=116b); see StW 116 for other associations.	
StW 118	Mandibular LI1; Part of StW 116 (=116c); see StW 116 for other associations.	
StW 119	Mandibular RC, Part of StW 116 (=116d); see StW 116 for other associations.	
StW 120	Mandibular LM2; Associated with StW 116 (probable); see StW 116 for other associations.	
StW 123a,b	Mandibular M1. Associated with StW 130.	
StW 126	Maxillary RC in ramus frag; Part of StW 183 (=183g); see StW 183 for other associations	
StW 127	Maxillary LC; Part of StW 183 (=183h); see StW 183 for other associations	
StW 128	Maxillary RM3; Part of StW 183 (=183j); see StW 183 for other associations	
StW 130	Part of StW 123 (=123b)	
StW 131	Mandibular teeth, right P4 and M1 withLP4; probably associated with StW 132, 133	
StW 132	Mandibular RC; Probably associated with StW 131, 133	
StW 145	Mandibular RM1; possibly associated with StW 147	
StW 147	Mandibular RP4; possibly associated with StW 145	
StW 151	Skull fragments with associated teeth: StW 151a-c, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 163, 165, 166, 167, 168, 170, 171, 172, 173, 174, 175, 176, 177, 178	
StW 152	See StW 151 for associations	
StW 153	See StW 151 for associations	
StW 154	See StW 151 for associations	
StW 155	See StW 151 for associations	
StW 156	See StW 151 for associations	
StW 157	See StW 151 for associations	
StW 158	See StW 151 for associations	
StW 159	See StW 151 for associations	
StW 160	See StW 151 for associations	
StW 161	See StW 151 for associations	
StW 163	See StW 151 for associations	
StW 165	See StW 151 for associations	
StW 166	See StW 151 for associations	
StW 167	See StW 151 for associations	
StW 168	See StW 151 for associations	
StW 169	Maxillary LI2; Associated with StW 126, 127, 128, 183, 245	
StW 170	See StW 151 for associations	
StW 171	See StW 151 for associations	
StW 172	See StW 151 for associations	
StW 173	See StW 151 for associations	
StW 174	See StW 151 for associations	
StW 175	See StW 151 for associations	
StW 176	See StW 151 for associations	
StW 177	See StW 151 for associations	
StW 178	See StW 151 for associations	
StW 179	Maxillary LM3	
StW 183	Left maxilla with P3, M1-M2; RI1 = 183a; R12 = 183b; Associated isolated teeth; Associated with StW 126, 127, 128, 169, 245	

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
StW 188	Maxillary RM2; Possibly associated with StW 189, 192a,b, 287	
StW 189	Maxillary LM3; Possibly associated with StW 188, 192a,b, 287	
StW 190	Mandibular molar frag	
StW 192	Maxillary LP3 (a); RP3 (b); Associated with StW 202; possibly associated with StW 188, 189, 287	
StW 196	Mandibular LM3	
StW 202	Maxillary RP3; Part of StW 192 (=192b)	
StW 204	Maxillary LM2 (a) (StW 204b = StW 206). Possibly associated with StW 208.	
StW 206	Maxillary RM2; Part of StW 204 (=204b); see StW 204 for other associations.	
StW 208	Maxillary RM1 (portion); Associated with StW 217; possibly associated with StW 204, 206.	
StW 209	Mandibular RI2	
StW 210	Mandibular RM2	
StW 213	Mandibular LM2; Associated with StW 222, 223, 230, 231, 232, 233, 235, 241, 378; probably associated with StW 270	
StW 217	Maxillary RM1 (portion); Part of StW 208 (see also StW 204).	
StW 222	Mandibular LC; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 223	Mandibular LM1 (cast; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 229	Maxillary premolar fragment (cast only -- original no longer exists)	
StW 230	Mandibular RC, Associated with StW 213 (possible); see StW 213 for other associations.	
StW 231	Mandibular RP3; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 232	Mandibular RP4; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 233	Mandibular LP3; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 234	Mandibular RM2	
StW 235	Mandibular RM2; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 241	Mandibular LP4; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 245	Maxillary LP3; Associated with StW 126, 127, 128, 169, 183	
StW 246	Mandibular LM1; probably associated with StW 97.	
StW 250	Maxillary LC; Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 251	Maxillary LP3; Part of StW 252a. Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 252	Skull pieces StW 252a-s, with associated complete maxillary permanent teeth. Associated with StW 250, 251, 253, 254, 255, 256, 257, 258, 259, 260, 262, 263, 265, 268	*Australopithecus*
StW 253	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 254	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 255	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 256	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 257	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 258	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 259	Associated with StW 252; see StW 252 for other associations; glued to StW 255	*Australopithecus*
StW 260	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 262	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 263	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 266	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 267	Isolated cranial remains; a-f	
StW 268	Associated with StW 252; see StW 252 for other associations.	*Australopithecus*
StW 269	Mandibular Rm2, part of StW 537 (=537h); see StW 537 for other associations.	
StW 270	Mandibular RI2. Associated with StW 213 (probable)	
StW 276	Mandibular LM1 (cast only -- original no longer exists)	
StW 277	Maxillary LM3; Associated with StW 280; see StW 280 for associations.	
StW 278	Mandibular RM3; Associated with StW 280; see StW 280 for associations.	
StW 280	Maxillary RP4 fragment with associated teeth; associated with StW 277, 278, 281, 282, 283, 284	
StW 281	Maxillary LP4; Associated with StW 280; see StW 280 for associations.	
StW 282	Maxillary RP3; Associated with StW 280; see StW 280 for associations.	
StW 283	Maxillary LM1, Associated with StW 280; see StW 280 for associations.	
StW 284	Maxillary LM2; Associated with StW 280; see StW 280 for associations.	
StW 287	Maxillary LC. Possibly associated with StW 188, 189, 192a,b	
StW 288	Mandibular RC	
StW 296	Hemi-mandible with L/R I1 and LI2; probably associated with StW 297, 305, 307, 308, 309a,b,	
StW 297	Mandibular Ldm1; Part of StW 296 (=296e)	
StW 303	Mandibular molar fragment (cast only -- original no longer exists)	
StW 305	Maxillary Ldc; Associated with StW 306	
StW 306	Maxillary LI1 crown, in bone; Associated with StW 305	
StW 307	Mandibular Rdm2; Associated with StW 296 (possible)	

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
StW 308	Mandibular RM2; Associated with StW 296 (possible)	
StW 309	Mandibular RM1; Associated with StW 409	
StW 315	Mandibular, Ldm2	
StW 317	Mandibular LI1; Associated with StW 412 (probable)	
StW 327	Mandibular corpus, left with P4, M1, M2, (M3)	
StW 332a,b	Mandibular RI2; possibly associated with StW 333, StW 334a,b.	
StW 333	Mandibular LI1; Possibly associated with StW 332	
StW 361	Femur, R prox frag	
StW 363	Talus, left	
StW 364	Mandibular RM1	
StW 378	Mandibular RM1; Associated with StW 213 (possible); see StW 213 for other associations.	
StW 379	Maxillary RC	
StW 396	Tibia, right proximal	
StW 402	Maxillary RM1	
StW 408	Maxillary LP3	
StW 409	Mandibular dm2; Part of StW 309 (=309b); possibly associated with StW 296	
StW 412	Mandibular, R/L M2s; probably associated with StW 317, 413, 414, 415, 419, 430	
StW 413	Mandibular LP4; See StW 412 for associations	
StW 414	Mandibular LC. See StW 412 for associations	
StW 415	Mandibular RI1. See StW 412 for associations	
StW 419	Mandibular LM2; Part of StW 412 (=412b). See StW 412 for other associations.	
StW 420	Mandibular RP3; associated with StW 427; probably associated with StW 421a,b, 424, 425, 429	
StW 421	Mandibular RM1; See StW 420 for associations	
StW 423	Maxillary RM3	
StW 424	Mandibular LM2; See StW 420 for associations	
StW 425	Mandibular RI2. See StW 420 for associations	
StW 427	Mandibular LP3, Part of StW 420 (=420b); see StW 420 for other associations	
StW 428	Mandibular Ldm2	
StW 429	Mandibular LM1; Part of StW 421 (=StW 421b), probably associated with StW 420	
StW 430	Mandibular RP3. See StW 412 for associations	
StW 446	Mandibular, LC; possibly associated with StW 447, StW 450	
StW 447	Maxillary RM2; See StW 446 for associations	
StW 450	Maxillary RM1; See StW 446 for associations	
StW 487	Mandibular LP4, RM3	
StW 488	Maxillary deciduous molar	
StW 525	Mandibular P4; probably associated with StW 526.	
StW 526	Mandibular P4; probably associated with StW 525.	
StW 537	Mandibular LC, isolated associated teeth. Associated with StW 269, 538, 539, 540, 541, 542, 543, 551	
StW 538	Manidbular RC, part of StW 537 (=537b). See StW 537 for other associations.	
StW 539	Mandibular RI2, part of StW 537 (=537c). See StW 537 for other associations.	
StW 540	Mandibular LM2, part of StW 537 (=537f). See StW 537 for other associations.	
StW 541	Mandibular LM1, part of StW 537 (=537e). See StW 537 for other associations.	
StW 542	Mandibular LP4, part of StW 537 (=537d). See StW 537 for other associations.	
StW 543	Mandibular LI2, part of StW 537 (=537g). See StW 537 for other associations.	
StW 551	Mandibular LM3 (551a) and RM3 (551b), part of StW 537 (=537i); see StW 537 for other associations.	
StW 559	Maxillary M3	
StW 560	Mandibular teeth, LM1, L/R M2-M3; Associated with StW 561; probably associated with StW 563a,b.	
StW 561	Mandibular LP4; Part of StW 560 (=560f). See StW 560 for associations.	
StW 563	Mandibular LP4; Probably associated with StW 560, 564. See StW 560 for associations.	
StW 566	Mandibular M1	
StW 567	Tibia, right distal	
StW 575	Phalanx, R pollical prixmal	
StW 585	Maxillary RC	*Homo;* Under Study/In Preparation
StW 586	Mandibular LM3	*Australopithecus*
StW 591	Unerupted upper incisor	*?Homo;* Under Study/In Preparation
StW 592	Unerupted upper molar	*?Homo;* Under Study/In Preparation
StW 599	Deciduous canine	*Australopithecus;* Under Study/In Preparation
StW 669	Tooth Upper R M1	*Homo?*
Taung1	Partial skull and endocast	*Australopithecus*
U.W. 88-1	Acromial end and lateral shaft of right clavicle; MH1	*Australopithecus*
U.W. 88-2	LC1 with anterolateral wall of mandibular corpus; MH1	*Australopithecus*
U.W. 88 – 3	Proximal Ulna; MH1	*Australopithecus*
U.W. 88 – 4	Proximal femur conjoins with UW88-5, 39; MH1	*Australopithecus*
U.W. 88 – 5	Proximal femur fragment conjoins with UW88-4, 39; MH1	*Australopithecus*
U.W. 88 – 6	Ilium- anterior portion of right ilium conjoins with U.W 88-7; MH1	*Australopithecus*
U.W. 88 – 7	Sacro Iliac- posterior portion of right ilium conjoins with U.W 88-6; MH1	*Australopithecus*
U.W. 88 – 8	Hemi-mandible with LM1, LM2 erupted, LM3 in crypt conjoins with U.W 88-2; MH1	*Australopithecus*
U.W. 88 – 9	Complete Cervical Vertebra; MH1	*Australopithecus*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
U.W. 88 – 11	Near Complete Thoracic vertebra; MH1	*Australopithecus*
U.W. 88 – 12	Distal radius – articular surface; MH1	*Australopithecus*
U.W. 88 – 13	Distal rib fragment; MH1	*Australopithecus*
U.W. 88 – 14	Near complete Ischium- Left; MH1	*Australopithecus*
U.W. 88 – 15	Proximal rib fragment – Left; MH1	*Australopithecus*
U.W. 88 – 17	Rib fragment; MH1	*Australopithecus*
U.W. 88 – 18	Fibula – Shaft fragment; MH1	*Australopithecus*
U.W. 88 – 22	Proximal fragment of a Metatarsal – right; MH1	*Australopithecus*
U.W. 88 – 27	Possible pelvic fragment; MH1	*Australopithecus*
U.W. 88 – 29	Right upper central Incisor; MH1	*Australopithecus*
U.W. 88 – 30	Mandibular canine- right, complete; MH1	*Australopithecus*
U.W. 88 – 31	Skull fragment joins to U.W 88- 32/50; MH1	*Australopithecus*
U.W. 88 – 32	Skull fragment joins to U.W88 31/50; MH1	*Australopithecus*
U.W. 88 – 34	Right Proximal Humerus conjoins with UW88 – 42,/88; MH1	*Australopithecus*
U.W. 88 – 36	Left Proximal Humerus; MH1	*Australopithecus*
U.W. 88 – 37	Thoracic vertebra – Pathology; MH1	*Australopithecus*
U.W. 88 – 39	Femoral head epiphysis fragment associated and articulates with 88-4; MH1	*Australopithecus*
U.W. 88 – 41	Half distal rib; MH1	*Australopithecus*
U.W. 88 – 42	Right Humeral shaft; MH1	*Australopithecus*
U.W. 88 – 50	Juvenile Skull with dentition present R + L P3-M3 joins with mandible U.W 88- 8; MH1	*Australopithecus*
U.W. 88 – 67	Pelvic fragment; MH1	*Australopithecus*
U.W. 88 – 68	Pelvic fragment associated with 88-102; MH1	*Australopithecus*
U.W. 88 – 69	Thoracic vertebra; MH1	*Australopithecus*
U.W. 88 – 70	Thoracic Vertebra; MH1	*Australopithecus*
U.W. 88 – 71	Cervical vertebra found near skull; MH1	*Australopithecus*
U.W. 88 – 72	Cervical vertebra; MH1	*Australopithecus*
U.W. 88 – 73	Cervical vertebra "Missing"; MH1	*Australopithecus*
U.W. 88 – 74	Rib fragment; MH1	*Australopithecus*
U.W. 88 – 75	Radial shaft fragment?; MH1	*Australopithecus*
U.W. 88 – 76	Distal end of fibula; MH1	*Australopithecus*
U.W. 88 – 77	unknown fragment associated with MH1	*Australopithecus*
U.W. 88 – 81	Infant distal humerus; MH3	*Australopithecus*
U.W. 88 – 82	Infant proximal ulna; MH3	*Australopithecus*
U.W. 88 – 86	Proximal rib; MH1	*Australopithecus*
U.W. 88 – 88	Right distal humerus articulates with 88-42; MH1	*Australopithecus*
U.W. 88 – 89	Femoral shaft fragment; MH1	*Australopithecus*
U.W. 88 – 90	Vertebral fragmant associated with 88-86; MH1	*Australopithecus*
U.W. 88 – 92	Lumbar vertebra; MH1	*Australopithecus*
U.W. 88 – 102	Ilium; MH1	*Australopithecus*
U.W. 88 – 112	Probable 3rd metacarpal; MH1	*Australopithecus*
U.W. 88 – 113	Right calcaneal apophysis; MH1	*Australopithecus*
U.W. 88 – 130	Possible long bone fragment, hominin?	Under Study/In Preparation
U.W. 88 – 131	Rib Fragment; MH1	*Australopithecus*
U.W. 88 – 132	Rib fragment attaches to 88-131; MH1	*Australopithecus*
U.W. 88 – 141	Rib fragment; MH1	*Australopithecus*
U.W. 88 – 148	Right 1st rib; MH1	*Australopithecus*
U.W. 88 – 152	Thoracic Vertebra; MH1	*Australopithecus*
U.W. 88 – 154	Rib found in block B245 along with the vertebra; MH1	*Australopithecus*
U.W. 88 – 168	Endocast 3D of MH1	*Australopithecus*
U.W. 88 – 170	Right Maxillary M3 printout (cast); MH1	*Australopithecus*
U.W. 88 – 171	Left mandibular fragment and impression joins to UW88-8; MH1	*Australopithecus*
U.W. 88 – 173	Possible femoral shaft	*Australopithecus*
U.W. 88 – 174	Left mandibular M3 printout; MH1	*Australopithecus*
U.W. 88 – 175	Possible femur, hominin?	Under Study/In Preparation
U.W. 88 – 176	Bone fragment, possibly mandibular?	Under Study/In Preparation
U.W. 88 – 186	Possible juvenile mandibular fragment	Under Study/In Preparation
U.W. 88 – 197	Scapula fragment; MH1	*Australopithecus*
U.W. 88 – 206	Pelvic fragment; MH1	*Australopithecus*
U.W. 88 – 211	Rib fragment; MH1	*Australopithecus*
U.W. 88 – 213	Intermediate phalanx and rib fragment	*Australopithecus*
U.W. 88 – 218	Unfused epiphysis	*Australopithecus*
U.W. 88 – 229	Maxillary right P3	*Australopithecus*
U.W. 88 – 231	Possible hominin phalanx, medial	*Australopithecus*
U.W. 88 – 239	Thoracic vertebra	*Australopithecus*
U.W. 88 – 244	Premolar crown, left associated with U.W. 88 – 245; MH1	*Australopithecus;* Under Study/In Preparation
U.W. 88 – 245	Mandibular left fragment with premolar roots, associated with U.W. 88 – 244; MH1	*Australopithecus*
U.W. 88 – 246	Premolar associated with U.W. 88 – 244 and U.W. 88 – 245; MH1	*Australopithecus;* Under Study/In Preparation
U.W. 88 – 248	Left partial mandible with M2 and M1; conjoins with UW88-2, 8, 245; MH1	*Australopithecus*
U.W. 88 – 825	Long bone shaft fragments (possibly hominin juvenile radius and ulna)	Under Study/In Preparation
U.W. 101-0014	Femur shaft fragment	*Homo*
U.W. 101-0020	Maxillary left first molar (M1) and small assoc frag	*Homo*
U.W. 101-0031	Right distal humerus fragment	*Homo*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
U.W. 101-0036	Right clavicle shaft fragment	*Homo*
U.W. 101-0042	Tibia shaft fragment	*Homo*
U.W. 101-0064	Longbone shaft fragment (cast only)	*Homo*
U.W. 101-0073	Maxillary right second incisor (I2)	*Homo*
U.W. 101-0080	Left talus	*Homo*
U.W. 101-0144	Mandibular left third premolar (P3)	*Homo*
U.W. 101-0145	Mandibular left second molar (M2)	*Homo*
U.W. 101-0182	Maxillary right third or fourth premolar (P3 or P4)	*Homo*
U.W. 101-0184	Mandibular left fourth premolar (P4)	*Homo*
U.W. 101-0244	Left first metatarsal	*Homo*
U.W. 101-0248	Left fourth metatarsal	*Homo*
U.W. 101-0259	Right proximal radius	*Homo*
U.W. 101-0277	Maxillary left fourth premolar (P4)	*Homo*
U.W. 101-0284	Mandibular left second molar (M2)	*Homo*
U.W. 101-0285	Mandibular right first molar (M1)	*Homo*
U.W. 101-0294	Mandibular left first molar root (M1) (refits to U.W. 101-905)	*Homo*
U.W. 101-0297	Mandibular right first molar (M1)	*Homo*
U.W. 101-0298	Mandibular right third premolar (P3)	*Homo*
U.W. 101-0333	Maxillary left fourth (or third?) premolar (P4)	*Homo*
U.W. 101-0335	Mandibular right second incisor (I2)	*Homo*
U.W. 101-0337	Maxillary right canine	*Homo*
U.W. 101-0339	Mandibular right canine	*Homo*
U.W. 101-0377	Mandible fragment with P3-M2, plus U.W. 101-1014 (canine) (DH7)	*Homo*
U.W. 101-0383	Mandibular right fourth premolar	*Homo*
U.W. 101-0384	Maxillary right deciduous second molar (dm2)	*Homo*
U.W. 101-0411	Distal humerus shaft fragment plus bag of fragments	*Homo*
U.W. 101-0418C	Left maxillary third molar (M3)	*Homo*
U.W. 101-0439	Thoracic vertebra fragment	*Homo*
U.W. 101-0445	Maxillary left first molar (M1)	*Homo*
U.W. 101-0455	Maxillary right fourth premolar (P4)	*Homo*
U.W. 101-0467	Right cuboid fragment (published as both −467 and −487)	*Homo*
U.W. 101-0486	Ilium fragment and mult fragments	*Homo*
U.W. 101-0498	Left tibia shaft	*Homo*
U.W. 101-0501	Maxillary left canine	*Homo*
U.W. 101-0505	Maxillary left second molar (M2)	*Homo*
U.W. 101-0506	Mandibular right third premolar (P3)	*Homo*
U.W. 101-0507	Mandibular right second molar (M2)	*Homo*
U.W. 101-0517	Third metacarpal diaphysis	*Homo*
U.W. 101-0525	Maxillary right first molar (M1) and bag of sediment	*Homo*
U.W. 101-0544A	Maxillary right deciduous second molar (dM2)	*Homo*
U.W. 101-0544B	Maxillary right canine germ	*Homo*
U.W. 101-0544C	Maxillary right deciduous first incisor (dI1)	*Homo*
U.W. 101-0559	Left third metacarpal	*Homo*
U.W. 101-0582	Mandibular left first molar (M1)	*Homo*
U.W. 101-0583	Maxillary right first molar (upper M1)	*Homo*
U.W. 101-0585	Multiple fragments, one is possible epiphysis	*Homo*
U.W. 101-0593	Maxillary right second molar (M2)	*Homo*
U.W. 101-0594	Maxillary right third molar (M3)	*Homo*
U.W. 101-0595	Maxillary left deciduous canine	*Homo*
U.W. 101-0600	Left proximal ulna fragment (refit to U.W. 101-853, −894, −1061)	*Homo*
U.W. 101-0601	Mandibular left first incisor (I1)	*Homo*
U.W. 101-0652	Cusp of tooth germ	*Homo*
U.W. 101-0655	Mandibular right second molar germ	*Homo*
U.W. 101-0703	Left proximal radius fragment	*Homo*
U.W. 101-0706	Maxillary left canine	*Homo*
U.W. 101-0708	Maxillary left first molar (M1)	*Homo*
U.W. 101-0709	Maxillary right second incisor (I2)	*Homo*
U.W. 101-0721	Third metacarpal distal epiphysis	*Homo*
U.W. 101-0723	Sacral vertebra	*Homo*
U.W. 101-0728	Maxillary right deciduous canine	*Homo*
U.W. 101-0786	Maxillary left third premolar (P3)	*Homo*
U.W. 101-0788	Distal femur fragment	*Homo*
U.W. 101-0789	Mandibular left second molar (M2)	*Homo*
U.W. 101-0791	Ischium fragment w 2 small fragments	*Homo*
U.W. 101-0801	Metatarsal head fragment	*Homo*
U.W. 101-0808	Maxillary left fourth premolar (P4)	*Homo*
U.W. 101-0809	Mandibular left first molar (M1)	*Homo*
U.W. 101-0814	Mandibular left first molar (M1)	*Homo*
U.W. 101-0816	Maxillary right canine	*Homo*
U.W. 101-0817	Left proximal fibula (DH7)	*Homo*
U.W. 101-0823	Maxillary right deciduous first molar (dM1)	*Homo*
U.W. 101-0824	Mandibular left deciduous canine (dC)	*Homo*
U.W. 101-0853	Ulna shaft fragment (refit to U.W. 101-600)	*Homo*
U.W. 101-0863	Left proximal long bone	*Homo*
U.W. 101-0867	Maxillary right second molar (M2)	*Homo*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
U.W. 101-0886	Mandibular right canine (C)	*Homo*
U.W. 101-0887	Mandibular left fourth premolar (P4)	*Homo*
U.W. 101-0888	Coccyx or sacrum fragment	*Homo*
U.W. 101-0889	Mandibular left third premolar (P3)	*Homo*
U.W. 101-0894	Ulna shaft fragment (refit to 600 with −1061)	*Homo*
U.W. 101-0905	Mandibular left first molar (M1) (refits to U.W. 101-294)	*Homo*
U.W. 101-0907	Left calcaneus (DH7)	*Homo*
U.W. 101-0910	Left talus and left navicular (DH7)	*Homo*
U.W. 101-0931	Maxillary left first incisor (I1)	*Homo*
U.W. 101-0932	Maxillary left second incisor (I2)	*Homo*
U.W. 101-0938a	Composite right proximal femur	*Homo*
U.W. 101-0938b	Right femur head	*Homo*
U.W. 101-0948	Right humerus (refit from U.W. 101-992 and −993) (DH7)	*Homo*
U.W. 101-0964	Right proximal ulna fragment	*Homo*
U.W. 101-0985	Mandibular left canine	*Homo*
U.W. 101-0996	Right tibia (refit with U.W. 101-1074 and −1077) (DH7)	*Homo*
U.W. 101-0997	Right navicular	*Homo*
U.W. 101-0998	Mandibular left second incisor (I2)	*Homo*
U.W. 101-0999	Maxillary right first molar (M1)	*Homo*
U.W. 101-1000	Right proximal femur, 2 large composite fragments plus mult small frags (DH7)	*Homo*
U.W. 101-1002	Mandibular right second molar (M2)	*Homo*
U.W. 101-1004	Maxillary right fourth premolar (P4) or P3	*Homo*
U.W. 101-1005A	Mandibular left first incisor (I1)	*Homo*
U.W. 101-1005B	Mandibular right first incisor (I1)	*Homo*
U.W. 101-1005C	Mandibular right second incisor (I2)	*Homo*
U.W. 101-1006	Maxillary right second molar (M2)	*Homo*
U.W. 101-1012	Maxillary right first incisor (I1)	*Homo*
U.W. 101-1014	Mandibular right canine	*Homo*
U.W. 101-1015	Maxillary left second molar (M2)	*Homo*
U.W. 101-1029	Metacarpal shaft fragment	*Homo*
U.W. 101-1045	Left fibula shaft (DH7)	*Homo*
U.W. 101-1061	Ulna shaft fragment (refit to U.W. 101-600)	*Homo*
U.W. 101-1063	Maxillary left second molar (M2) germ	*Homo*
U.W. 101-1067	Distal femur fragment (refit to U.W. 101-938)	*Homo*
U.W. 101-1068	Femur shaft fragment (refit to U.W. 101-938)	*Homo*
U.W. 101-1070	Left tibia, almost complete (DH7)	*Homo*
U.W. 101-1074	Right tibia (refit to U.W. 101-996)	*Homo*
U.W. 101-1075	Mandibular right second incisor (I2)	*Homo*
U.W. 101-1076	Mandibular left canine	*Homo*
U.W. 101-1077	Right tibia (refi to U.W. 101-996)	*Homo*
U.W. 101-1088	Ischium fragment (DH7)	*Homo*
U.W. 101-1098	Femur head epiphysis (associated with U.W. 101-1000) (DH7)	*Homo*
U.W. 101-1100	Ilium fragment	*Homo*
U.W. 101-1107	Maxillary left fourth (or third?) premolar (P4)	*Homo*
U.W. 101-1120	Distal femur epiphysis plus 6 smaller fragments	*Homo*
U.W. 101-1126	Mandibular left canine	*Homo*
U.W. 101-1131	Mandibular left second incisor (I2)	*Homo*
U.W. 101-1132	Mandibular left first incisor (I1)	*Homo*
U.W. 101-1133	Mandibular right first incisor (I1)	*Homo*
U.W. 101-1135	Maxillary right second molar (M2) germ	*Homo*
U.W. 101-1159	Bone fragments	*Homo;* Under Study/In Preparation
U.W. 101-1160	Thoracic vertebrae fragments	*Homo;* Under Study/In Preparation
U.W. 101-1161	Lumbar vertebrae fragments	*Homo;* Under Study/In Preparation
U.W. 101-1162	Bone fragments	*Homo;* Under Study/In Preparation
U.W. 101-1229	Clavicle, right in 3 refit fragments	*Homo*
U.W. 101-1242	Intermediate cuneiform, right	*Homo*
U.W. 101-1271	Metacarpal shaft fragment (DH7)	*Homo*
U.W. 101-1272	Mandible fragment, part of U.W. 101-1400?	*Homo*
U.W. 101-1287A	Maxillary left deciduous canine	*Homo*
U.W. 101-1292	Radius, two fragments plus 4 smaller frags	*Homo;* Under Study/In Preparation
U.W. 101-1293	Ulna shaft fragment	*Homo*
U.W. 101-1304	Maxillary left deciduous second incisor (I2)	*Homo*
U.W. 101-1305	Maxillary left first molar (M1) germ	*Homo*
U.W. 101-1331	Maxillary left deciduous first incisor (I1)	*Homo*
U.W. 101-1340	Humerus shaft fragment	*Homo*
U.W. 101-1353	Scapula fragment, right	*Homo*
U.W. 101-1368	Fourth metatarsal, right	*Homo*
U.W. 101-1376	Maxillary left deciduous second molar (M2) and bone fragment	*Homo*
U.W. 101-1377	Maxillary left deciduous first molar (M1)	*Homo*
U.W. 101-1400	Mandible fragment with Ldc1-LM1, LI2 germ, and fragments (DH6)	*Homo*
U.W. 101-1414	Ischium fragment, left plus 6 smaller fragments	*Homo*
U.W. 101-1423	Upper thoracic vert (neural arch)	*Homo*
U.W. 101-1459	Cranial fragment (left ramus of U.W. 101-1400?)	*Homo*
U.W. 101-1483	Hallux, right proximal epiphysis	*Homo*
U.W. 101-1484	Phalanx, right intermediate pedal	*Homo*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
U.W. 101-1499	Second metatarsal, right and right first metatarsal epiphysis	*Homo*
U.W. 101-1500	Third metatarsal, right	*Homo*
U.W. 101-1516	Phalanx, proximal manual shaft fragment	*Homo*
U.W. 101-1520	Fibula shaft fragment, three pieces	*Homo*
U.W. 101-1522	Maxillary left second molar (M2)	*Homo*
U.W. 101-1523	Femoral shaft fragment, right distal	*Homo*
U.W. 101-1536	Metacarpal shaft fragment (DH7)	*Homo*
U.W. 101-1543	Humeral head epiphysis	*Homo;* Under Study/In Preparation
U.W. 101-1548	Maxillary left canine germ	*Homo*
U.W. 101-1552	Phalanx, proximal manual epiphysis	*Homo*
U.W. 101-1555	Femur neck fragment, left plus partial femur head	*Homo*
U.W. 101-1571	Mandibular left deciduous canine	*Homo*
U.W. 101-1574	Maxillary right first molar (M1) root (refits to U.W. 101-525)	*Homo*
U.W. 101-1588	Maxillary left second incisor (I2)	*Homo*
U.W. 101-1605	Mandibular left molar (?) germ frags	*Homo*
U.W. 101-1610	Mandibular right canine germ	*Homo*
U.W. 101-1611	Mandibular right deciduous canine	*Homo*
U.W. 101-1612	Mandibular right deciduous second incisor	*Homo*
U.W. 101-1617	Calcaneus epiphysis	*Homo;* Under Study/In Preparation
U.W. 101-1623	Talus fragment, right	*Homo*
U.W. 101-1633	Metacarpal shaft fragment (DH7)	*Homo*
U.W. 101-1635	Phalanx, proximal manual shaft fragment (DH7)	*Homo*
U.W. 101-1636	Metacarpal shaft fragment (DH7)	*Homo*
U.W. 101-1654	Metacarpal shaft fragment	*Homo*
U.W. 101-1657	Phalanx, proximal pedal	*Homo*
U.W. 101-1662	Calcaneus fragment, right	*Homo*
U.W. 101-1664	Phalanx, manaul intermediate (DH7)	*Homo*
U.W. 101-1673	Cervical vertebra fragment (R neural arch)	*Homo*
U.W. 101-1676	Maxillary left first molar (M1)	*Homo*
U.W. 101-1682	Cuneiform, left intermediate	*Homo*
U.W. 101-1683	Femur, distal epiphysis	*Homo;* Under Study/In Preparation
U.W. 101-1685	Mandibular right deciduous first molar (dM1)	*Homo*
U.W. 101-1686	Mandibular right deciduous second molar (dM2)	*Homo*
U.W. 101-1687	Maxillary right deciduous second molar (dM2)	*Homo*
U.W. 101-1688	Maxillary right first molar (M1) germ	*Homo*
U.W. 101-1689	Mandibular right first molar (M1) germ	*Homo*
U.W. 101-1690	Mandibular fragments associated with 1685-1689	*Homo*
U.W. 101-1692	Second cervical vertebra fragment with odontoid process	*Homo*
U.W. 101-1694	Femur condyle, right	*Homo*
U.W. 101-1715	Metacarpal head	*Homo*
U.W. 101-1743	Epiphyseal fragments	*Homo*
U.W. 101-1746	Vertebral lamina	*Homo;* Under Study/In Preparation
U.W. 101-1754	Ischium fragment, right conjoins w 1755 (associated with U.W. 101-938a,b)	*Homo*
U.W. 101-1755	Ischium fragment, right conjoins w 1754 (associated with U.W. 101-938a,b)	*Homo*
U.W. 101-2074	Jacketed fossil mass (Jacket #1)	*Homo;* Under Study/In Preparation
U.W. 101-2075	Jacketed fossil mass (Jacket #2)	*Homo;* Under Study/In Preparation
U.W. 101-2076	Jacketed fossil mass (Jacket #3)	*Homo;* Under Study/In Preparation
U.W. 101-2096	Tibia?	*Homo;* Under Study/In Preparation
U.W. 101-2192	Premolar germ	*Homo;* Under Study/In Preparation
U.W. 101-2193	Deciduous incisor	*Homo;* Under Study/In Preparation
U.W. 101-2194	Premolar germ	*Homo;* Under Study/In Preparation
U.W. 101-2204	Scapula fragment	*Homo;* Under Study/In Preparation
U.W. 101-2243	Humerus, proximal	*Homo;* Under Study/In Preparation
U.W. 101-2250	Femur, right proximal fragment plus shaft fragments	*Homo;* Under Study/In Preparation
U.W. 101-2260	Femur, proximal	*Homo;* Under Study/In Preparation
U.W. 101-2269	Bone fragment	*Homo;* Under Study/In Preparation
U.W. 102a-018	Long bone fragment	*Homo*
U.W. 102a-138	Ilium fragments, right	*Homo*
U.W. 102a-210	Sacral element	*Homo*
U.W. 102a-474	Long bone fragment	*Homo*
U.W. 102b-178	Mandibular left I2 crown	*Homo*
U.W. 102b-437	Mandibular left dm2	*Homo*
U.W. 102b-438	Mandibular corpus fragment, right P4 crown in crypt	*Homo*
U.W. 102b-502	Cranial fragments	*Homo*
U.W. 102b-503	Maxillary P4 crown, right	*Homo*
U.W. 102b-506	Cranial fragment	*Homo*
U.W. 102b-507	Cranial fragment	*Homo*
U.W. 102b-509	Cranial fragment	*Homo*
U.W. 102b-511	Mandibular left canine crown	*Homo*
U.W. 102b-514	Cranial fragment	*Homo*
U.W. 102b-515	Maxillary left I2	*Homo*
U.W. 102b-516	Cranial fragment	*Homo*
U.W. 110-1	Maxillary right deciduous second molar (dm2)	*Homo*
U.W. 110-2	Maxillary right fourth premolar (P4) crown germ	*Homo*
U.W. 110-3	Cranial fragment	*Homo*

(*Continued*)

Table 2. Continued.

Specimen no	Material and associations	Identification
U.W. 110-4	Cranial fragment	*Homo*
U.W. 110-5	Maxillary right first molar (M1) crown	*Homo*
U.W. 110-6	Cranial fragments	*Homo*
U.W. 110-7	Cranial fragment	*Homo*
U.W. 110-8	Cranial fragment	*Homo*
U.W. 110-9	Cranial fragment	*Homo*
U.W. 110-10	Cranial fragment	*Homo*
U.W. 110-11	Cranial fragment	*Homo*
U.W. 110-12	Cranial fragment	*Homo*
U.W. 110-13	Cranial fragments	*Homo*
U.W. 110-14	Maxillary right first incisor (I1) germ	*Homo*
U.W. 110-15	Mandibular left second incisor (I2) germ	*Homo*
U.W. 110-16	Cranial fragments	*Homo*
U.W. 110-17	Maxillary left decidous second molar (dM2)	*Homo*

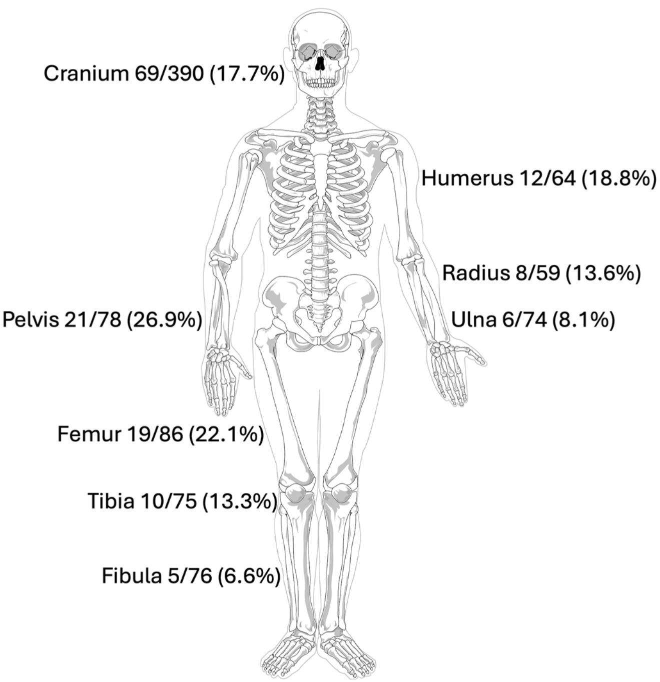

Figure 2. Breakdown of immature fossil material by key skeletal regions.

Results

Catalogued specimens number 3,277 entries comprising the hominin inventory of extinct species in the Wits fossil hominin collections. Of these, 650 entries (19.8%) sort as Pre-Adults.

The attached Table 2 compiles all the Pre-Adult specimens assessed in this study. Note that the Wits Catalogue is a "living document" that is continuously being updated. Backlogs and delays may occur in accessioning new materials, and in incorporating recently published materials. The Wits Catalogue is continuously expanding as fossils are submitted to the University, as permit holders prepare specimens, as updates are made to site catalogues, and as discoveries become published. Table 2 therefore represents a subset of this living document as of December 2024.

A general breakdown of major bone categories by maturity status is summarised in Figure 2. The full Wits Accessions Catalogue from which the Table 2 dataset has been extracted is available to researchers from the Wits University Collections Curator. See also edited volumes and monographs that provide in-depth, site-specific inventory analyses (e.g. Sterkfontein postcrania: Zipfel et al. 2020; Rising Star dentition: Delezene et al. 2023; see Table 1 for more information). Cranial bones include mandibular and maxillary bones. A catalogue entry was counted once for a bone region, for example, if a cranial bone and a mandible were listed under one accession number, then only one count was recorded. This approach skews data to underrepresent specimens that are more complete, or that after reconstruction were given only one accession entry. In the case of StW 573, a partial adult skeleton with only one accession number, each bone from the postcranial skeleton was included in the count for body region, and the skull was counted once for cranial material.

It should be noted that 669 specimens (20.4%) are catalogued but currently are under study/in preparation by the primary researchers and collaborators. 701 (21.4%) of accessioned entries were indeterminate for maturity status due to their state of preservation, their fragmentary nature and/or their lack of bone identification.

Discussion

The comprehensive inventory of South African Pre-Adult hominins at Wits University documents numerous immature fossils across three genera: *Australopithecus, Paranthropus* and *Homo*.

The accessions system varies by locality, which affects the characterisation of the proportion of Pre-Adult and Adult specimens overall (see Figure 2). For example, the excellent preservation at Sterkfontein of a nearly complete *Australopithecus* adult skeleton "Little Foot" is accessioned only as one element—StW 573—in the Wits Catalogue, although it includes a skull with full dentition, a nearly complete left hand, and an additional 79 postcranial elements (Clarke 2019). Likewise, the famous Taung Child is represented by only one accession entry (Taung 1) but includes a partial cranium and mandible with mixed deciduous and permanent dentition and a fossilised endocast. These robustly documented specimens contrast with entries that represent only a single element, like MLD 43 for example, a maxillary central incisor from Makapansgat. In some instances, associated specimens have been renumbered to an alphabetical system, as is the case for the adult partial skeleton StW 431 (cf. Toussaint et al. 2003). StW 432 has been renumbered StW 431b, StW 433 renumbered StW 431c.

Fossils excavated at Kromdraai from 2014 onward are housed at Wits University (Braga et al. 2017, 2022). Of the 36 entries in the Wits Catalogue, 20 (56%) are assessed as immature (Braga et al. 2021, 2022, 2023; Braga and Grine 2024; Zimmer et al. 2023). This material from Kromdraai Unit P represents a possible minimum number of eight immature and eight adult individuals attributed to *Paranthropus* and two immature and one adult individual of *Homo* (Braga et al. 2022; Harper et al. 2022). The collections from the sites of Kromdraai, Sterkfontein and Swartkrans have been split between two repositories, and thus the results in Table 2 do not represent the entirety of immature remains for these sites.

Preservation and deposits vary by locality, which may affect the accessions of specimens. The Rising Star site has a minimum of 29 individuals from multiple cave deposits. Many of the specimens were broken or damaged during the fossilisation process and therefore recovered in fragments (Berger et al. 2015; Dirks et al. 2015). For example, the cranium of adult *Homo* DH 1 is comprised of 22 fragmented elements that was reconstructed after excavation and so each has its own accession number (Berger et al. 2015; Dirks et al. 2015; Laird et al. 2017). An adult partial skeleton LES 1 was excavated from one deposit (Hawks et al. 2017). Fifty-seven adult craniodental refitted elements comprise the *Homo* skull from the Lesedi Chamber, and all these skull elements share the same accessions number (LES 1), while the 53 postcranial elements generally have separate numbers (Figure 3) (Hawks et al. 2017). One juvenile individual was reintegrated in the laboratory as a partial skeleton, DH 7, represented by 18 craniodental and postcranial elements. The DH 7 elements do not all have separate accession numbers (tarsals), and some fragments of one element (fibula) have distinctive accession numbers, as the material was excavated from a commingled deposit of *Homo* fossils (Figure 4) (Bolter et al. 2020). In brief, the preservation and deposition ultimately may reflect

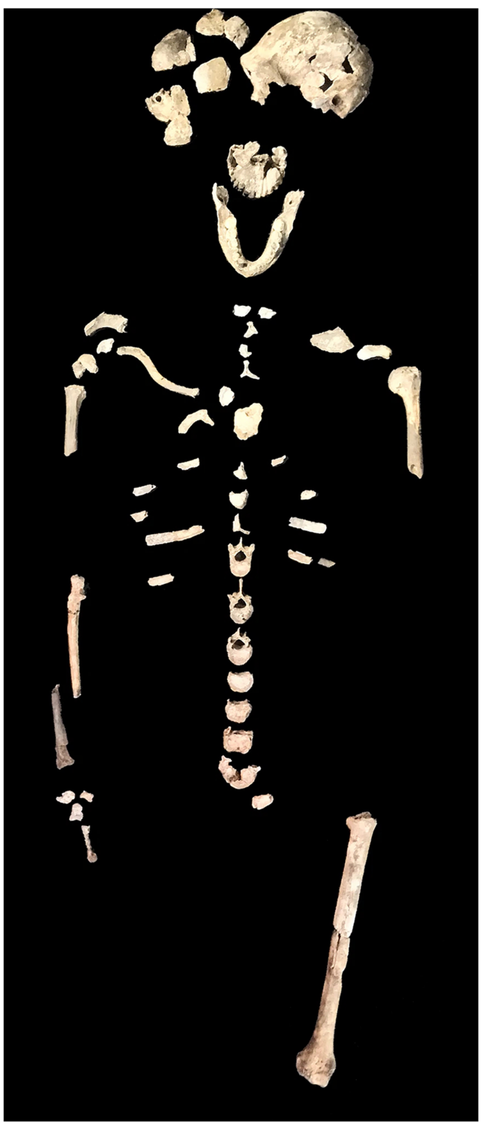

Figure 3. LES 1 partial adult *Homo* skeleton from Rising Star. The cranium is reconstructed from 57 elements along with 53 postcranial elements (not all pictured). Image from Hawks et al. (2017).

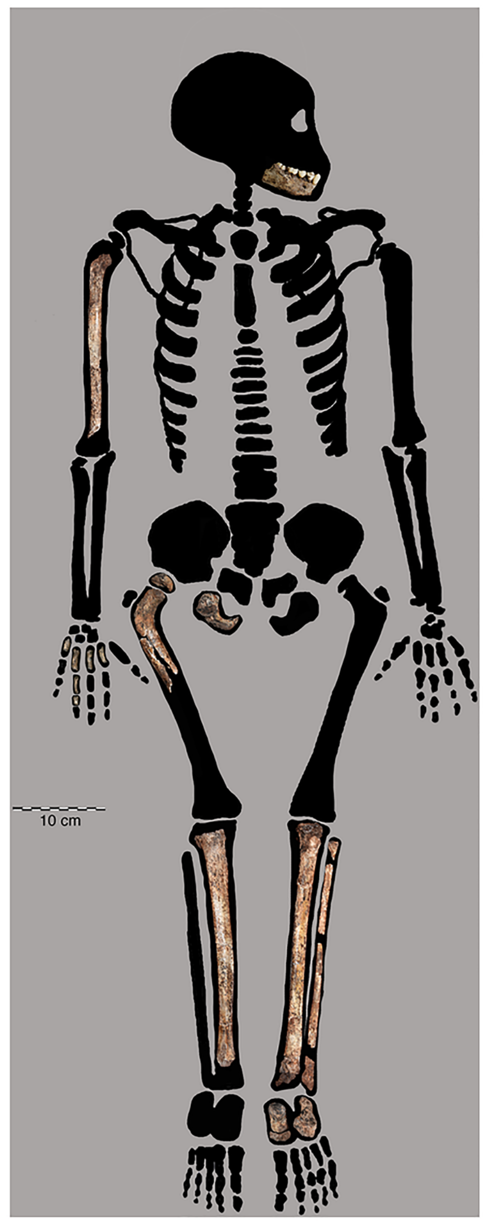

Figure 4. DH 7, juvenile partial *Homo* skeleton from Rising Star. The partial mandible with 4 teeth, a canine, and 16 postcranial elements were reintegrated in the lab, after excavation. Image from Bolter et al. (2020).

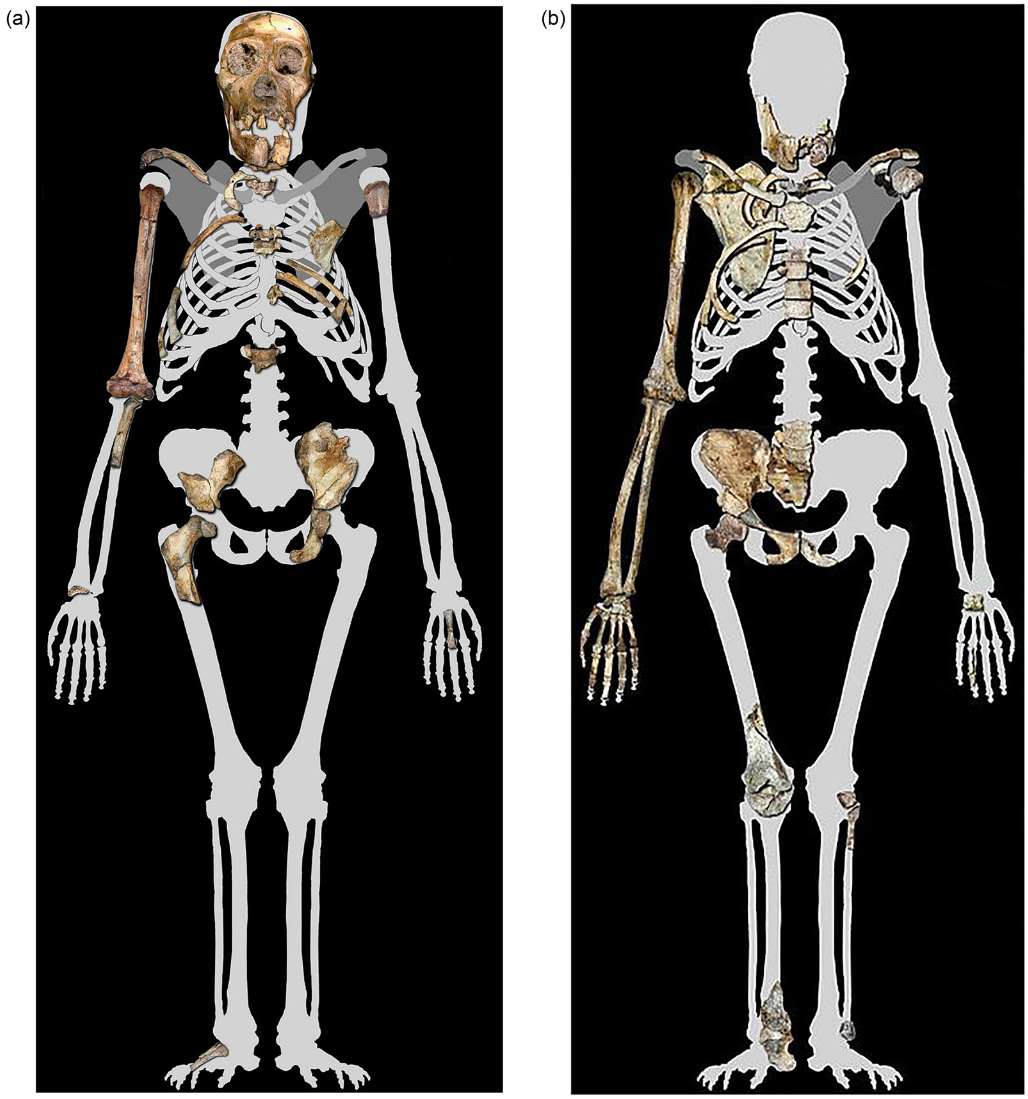

Figure 5. (a) Left: Immature *Australopithecus* MH 1 which currently comprises 23.8% of the Malapa assemblage. (b) Right: Adult *Australopithecus* MH 2 represents 45.8%. Note that not all body elements are pictured, e.g. additional MH 1 elements are currently under preparation and MH 2 lumbar vertebrae have been more recently recovered from *ex situ* blocks (e.g. Williams et al. 2021). Lee R. Berger. Image by Peter Schmid, slightly modified with MH 1 right tibia removed as it is no longer associated (after Bolter et al. 2025).

disproportionate entries into the accessions catalogue, either multiple entries for one body element (e.g. cranium) or multiple entries for one individual (e.g. fragmented bones with multiple postcranial elements).

At Drimolen, currently 68 entries out of 167 (40.7%) assess as Pre-Adult. Most of the immature fossils are *Paranthropus* (Keyser et al. 2000; Moggi-Cecchi et al. 2010; Martin et al. 2020; Leece et al. 2022; Leece et al. 2023), while one partial cranium, DNH 134, is assigned to the genus *Homo* (Herries et al. 2020). There are more fossil elements represented than there are entries due to accession practices. An adult skull with full dentition is represented by one catalogue entry (e.g. DNH 7). An adult mandible with dentition is likewise accessioned under one number (e.g. DNH 8). Thus, the proportionate ratio of immature to mature specimens varies based on how the data are considered. If analysed by dentition, immatures represent a higher number of specimens at Drimolen. 133 out of 248 teeth, or 53.6%, are from Pre-Adult individuals.

The Malapa site contributes 277 catalogued items of the 3,277 hominin specimens in the Wits collections. 66 items (23.8%) are attributed to the immature *Australopithecus* MH 1 partial skeleton, and 127 elements (45.8%) to the adult MH 2 partial skeleton (Berger et al. 2010; Berger 2013) (Figure 5a,b). An infant (MH 3) is currently identifiable by two upper limb elements, and a fourth adult individual (MH 4) is identifiable by a lower limb bone refit from two pieces, and there may be additional individuals (de Ruiter et al. 2013; Holliday et al. 2018).

Of the 639 specimen entries from Sterkfontein in the Wits Catalogue, 187 entries are assessed as Pre-Adult fossils (29.5%). One partial skull with associated mixed dentition of an immature hominin, StW 151, comprises 25 of the 187 (13.4%) Pre-Adult Sterkfontein entries (Moggi-Cecchi et al. 1998). These 25 entries encompass 66 total elements: 11 deciduous teeth, 25 permanent teeth (some still in their crypts), and 26 craniomandibular bones and fragments (Moggi-Cecchi et al. 1998).

Zipfel and Berger (2009) suggest that each fossil specimen have its own, unique number to standardise the accessions system across the Wits Collection. This approach reduces confusion and avoids renumbering, and may provide a better basis for comparing fossil data across localities. The standardisation further permits flexibility when multiple elements are associated as one individual, or if elements are later determined to have been misidentified in their associations.

Summary and conclusion

This catalogue inventory establishes a foundation for several future avenues of analysis for South African hominins, for example: Examination by skeletal element/region for each site and genus; comparisons and evaluations of craniodental versus postcranial remains between Pre-Adults and Adults for each site and genus; research into taphonomic factors affecting deposits, like the investigation of hypotheses regarding predator accumulations of smaller hominins (see Pickering et al. 2004). Furthermore, this dataset provides excavation teams with an additional method to evaluate the contribution of new South African immature hominin discoveries.

Overall, the inventory of South African hominins curated at the University of Witwatersrand identifies approximately one-fifth of the entries are immature. This immature catalogue facilitates research to incorporate fossils across the life span, to investigate variations in pre-adult morphologies across genera, and to examine patterns of accumulations within individual sites.

Disclosure statement

This article was submitted to the Human Origins & Survival section of *Annals of Human Biology* (AHB) for which one of the authors is the Section Editor. The Section Editor was recused from handling this article and it was assigned to another AHB Editor for independent and anonymous peer-review. In no way was this author involved in the editorial process for this article.

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