GEOLOGICAL MAP OF THE VARISCAN BASEMENT OF THE SOUTHERN GENNARGENTU MASSIF (CENTRAL SARDINIA, ITALY): TECTONICS, ORE BODIES AND GAMMA RAY LOGGING.

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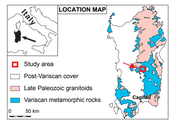


Map projection: Gauss-Boaga Transverse conformal projection (Italian National System), Geo-datum: Rome 40 (Hayford spheroid);Vertical Datum: mean sea level.

Topographic base map from Technical Regional Cartography- Regione Autonoma della Sardegna ©.

LEGEND

POST VARISCAN COVERS

- Q — **Quaternary deposits:** Alluvial and colluvial deposits; (Holocene - Pleistocene).
- DOR — **Dorgali Formation:** Dolostones, sandy dolostones and dolomitic limestones of littoral to circa-littoral environment (Middle - Late Jurassic).
- GNS — **Genna Selole Formation:** Conglomerates, quartz sandstones, siltstones, mudstones, alternating carbonaceous beds (Middle Jurassic).

VARISCAN VOLCANIC COMPLEX

- PE — Volcanic breccias and conglomerates (Early Permian?).
- fp — Quartz-Porphyritic dykes (Permian?).
- fm — Mafic dykes (Permian?).
- Sk — Skarn: Chalcopyrite, Galena, Blende, Magnetite, Pyrite, Silver, traces of Gold (?Late Carboniferous - Early Permian).
- Gra — Equigranular, fine-grained granodiorites (299+/- 3 Ma).

VARISCAN METAMORPHIC BASEMENT

Barbagia Tectonic Unit

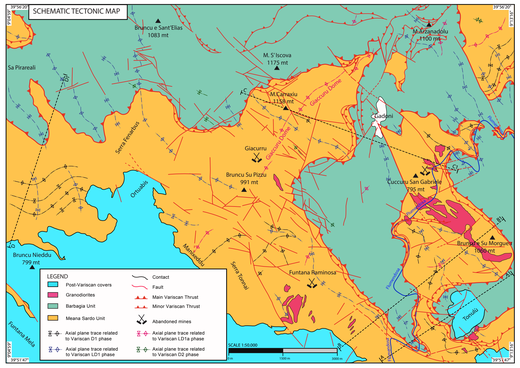
- GNN / Ark — **Filladi Grigie del Gennargentu:** Grey to greenish, alternating quartzitic metasandstones and micaceous metasandstones, interbedded with metapelites; **Ark**: Metarkoses and arkosic metagreywackes,quartzites (?Cambrian - ?Early Ordovician). Only found in two small areas in the eastern part of the study area.

Meana Sardo Tectonic Unit

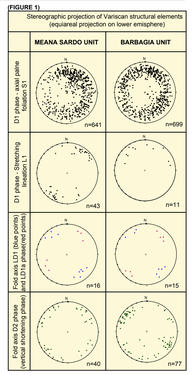
- SGA — **Scisti a Graptoliti:** Carbonaceous metapelites bearing graptolites, metasiltstones and black cherts; a) dark metalimestones and fossiliferous metalimestones (Silurian - Early Devonian).
- ORR — **Orroeleddu Formation:** Gray to greenish fine grained metasandstones, metapelites and metasiltstones; a) metarkoses and arkosic metagreywackes,quartzites and metaconglomerates (Late Ordovician).
- MSV — **Monte Santa Vittoria Formation:** Yellow to green intermediate metavolcanites and volcanic metagreywackes; rare, rhyolitic light coloured metavolcanilites, from afiric to porphyritic for phenocrysts of quartz and Pl (Middle - Late Ordovician).
  - **a) Manixeddu Fm:** metaconglomerates with prevaling clasts of acid volcanisc rocks.
  - **b) Serra Tonnai Fm:** metavolcanites, metagreywackes, metaepiclastites, intermediate end basic composition.
  - **c) M. Corte Cerbos Fm:** rhyolitic metavolcanites, metatuffites end metaepiclastites.
- SVI — **Arenarie di San Vito:** Grey to greenish, alternating quartzitic metasandstones and micaceous metasandstones, interbedded with metapelites (Middle Cambrian - Early Ordovician). Only found in the northeastern and southwest part of the study area.

SYMBOLOGY

- Bedding attitude.
- Relict foliation (Sr) probably related to an early stage of the Variscan D1 phase; in the Barbagia Unit it is recognized in the micro-lithons defined by S1.
- Fold axis and axial plane foliation related to the Variscan D1 phase; main foliation S1 in the Meana Sardo and Barbagia Unit.
- Stretching lineation related to the Variscan D1 phase.
- Fold axis and axial plane foliation related to the Variscan LD1 phase.
- Fold axis related to the Variscan LD1a phase.
- Fold axis related to the Variscan D2 phase.
- Shear sense indicator related to the reactivation of D1 thrust as low-angle normal fault during the D2 phase.
- Axial plane trace of synform and antiform related to the Variscan D1 phase. Small arrow indicates the overturning direction.
- Axial plane trace of synform and antiform related to the Variscan LD1 phase. Small arrow indicates the overturning direction.
- Axial plane trace of synform and antiform related to the Variscan LD1a phase. Small arrow indicates the overturning direction.
- Axial plane trace of synform and antiform related to the Variscan D2 phase. Small arrow indicates the overturning direction.
- Contact, observed and uncertain.
- Angular Unconformity.
- Fault, observed and uncertain; sense of motion unknown.
- Strike slip fault observed and uncertain.
- Normal fault, observed and uncertain.
- Main Variscan thrust, observed and uncertain.
- Secondary Variscan thrust, observed and uncertain.
- my — Mylonite related to the Variscan shortening phases with unrecognizable protolite
- Mylonite on recognizable protolite.
- Contact (thermal) metamorphism.
- Urban area where geological boundaries are not detectable.
- Sample analysed for spectrometry (for values see in the Figure2).
- U-Pb age GR110 (299+/- 3 Ma).
- D — D1 — Trace of geological cross-section.
- Abandoned Mine.



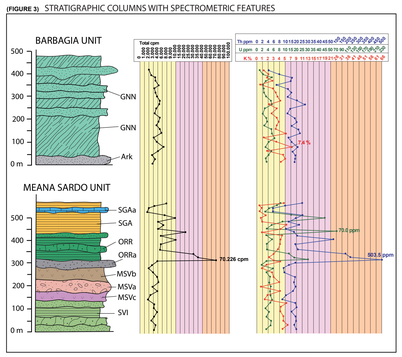
(FIGURE 1)



(FIGURE 2) FIELD GAMMA-RAY DATA IN THE GADONI AREA

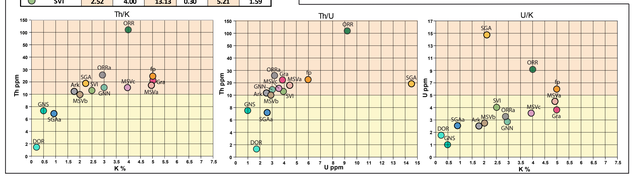
N°	Total(cpm)	K[%]	U[ppm]	Th[ppm]	N°	Total(cpm)	K[%]	U[ppm]	Th[ppm]	N°	Total(cpm)	K[%]	U[ppm]	Th[ppm]	N°	Total(cpm)	K[%]	U[ppm]	Th[ppm]	N°	Total(cpm)	K[%]	U[ppm]	Th[ppm]
1	3738.2	3.3	6.7	14.5	41	5423.5	3.5	11.1	18.4	81	4442.4	3.3	2.6	14.5	121	5890.2	3.6	16.9	24.7	161	4403.5	3.5	3.5	21.8
2	7958.9	4.6	8.2	26	42	4191	3.8	3.4	20.3	82	4585.3	2.7	3.5	14.7	122	5642.4	3.8	3.3	17.2	162	3757	2.2	3.1	12.5
3	1175	0.3	3.3	4.9	43	7030.7	3.2	5.9	13.3	83	5173.9	3.6	4.3	15.8	123	3160.7	1.5	2.4	11.6	163	5913.3	4.3	3.4	19.6
4	8262.2	1.4	19.6	14.5	44	9092.8	2.9	3.5	35.3	84	4936.2	3.1	3.9	14.1	124	2377.9	0.7	3.7	8.8	164	6924.7	5.4	3.3	22.3
5	12670.4	0.5	37.1	18	45	4616.2	3.5	3.9	48.4	85	4829.9	3.3	3.8	14.9	125	3630	2.5	3.1	9.4	165	1710.1	1	1.8	5.2
6	4374.5	0.8	8.6	12.8	46	2119.8	0.7	5.9	8.9	86	4389.1	2.4	3	14.6	126	3330.6	2.4	2.2	8.6	166	2634.8	1.1	3.9	8
7	2071.5	5	4.6	22.3	47	3319.6	1.8	4.1	13.0	87	6118.3	4.1	4.7	19.9	127	4838.1	2.7	4.2	16.9	167	8092.1	4.7	4.6	32.2
8	4921.8	4	3.3	10.3	48	2355.2	3.2	3.9	13.3	88	6495.5	4.5	3.5	21.2	128	5007.6	3.4	3.8	15	168	7391.3	5	4.4	22.8
9	15306.6	0.7	45.6	15.1	49	14330.2	3.3	7.3	78.8	89	7661.9	6.3	3.7	20	129	3285.1	1.6	3.2	11.7	169	8423	4.4	4.4	32
10	2016.8	0.2	3.3	5.8	50	4757.5	3.1	4.1	13.9	90	6196.9	4.7	3.9	16.9	130	3898.3	1.9	3.3	13.8	170	8408.3	4.5	5	32.9
11	21963.3	0.8	70	17	51	4882.7	3.9	4.3	15.2	91	6329	4.9	3.2	18.8	131	9670.7	6.7	3.1	25.5	171	28050.5	5.5	12.8	166.4
12	8918.5	6.6	9.1	19.3	52	5245.6	3.5	4.3	15.8	92	7650.6	5.1	4.7	24.8	132	3076.7	1.7	2	10.8	172	32465.8	5	15.4	208.1
13	4159.9	1.2	5.3	14.6	53	5514.5	3.8	3.6	17.7	93	5968.7	4.3	3	17.5	133	4679.8	3.6	3.9	10.4	173	7903.7	4.5	3.7	24.3
14	6358.2	1.3	12.7	13.4	54	8056.6	7.4	3.3	20.8	94	6453	4.5	3.7	21.2	134	5581.5	4	3.2	15.4	174	9323.8	5.9	6.1	35.2
15	1654.4	0.6	2	5.1	55	4346.5	1.7	5	15.7	95	6995.4	5.5	4	21.6	135	2720.7	1.3	2.8	8.8	175	3836	0.8	3.2	19.9
16	8037.5	5.7	6.2	21	56	5490.4	3.9	3.6	14.1	96	7010.5	4.9	3.7	21.7	136	9508	7.1	6.1	23.9	176	5299.7	3	4.8	18.9
17	4980.3	3.1	4.2	16.2	57	4380.2	1.9	4.4	16.3	97	3443.6	3.3	1.7	7.1	137	3887.4	3.5	2.2	8.3	177	10747.9	3.4	6.3	55.2
18	5186.5	3.9	3.5	15.8	58	6361.6	2.2	4.9	27	98	3052.9	2	2	9.3	138	14267.8	2.8	5.9	94	178	39108.6	3.9	16.2	273.1
19	4555.7	3.7	3.1	16.8	59	4156.8	2.5	2.5	14.4	99	639.7	0.2	1.3	1.1	139	8330.2	6.3	8.2	18.1	179	44075.5	5.5	21.6	300
20	7447.4	5.4	5.6	22.4	60	3227.4	2	2.5	9.8	100	4257.2	3.5	2.1	9.2	140	3219.6	0.6	2.4	17	180	37008.5	3.8	17.9	248.7
21	7849	6.7	5.5	17.2	61	1050	0.2	2.2	1.7	101	2853.5	1.8	2.2	9.9	141	5701	3.9	4.2	16.4	181	65958.1	3.7	28.9	475.4
22	7532.3	3.6	7.1	29.5	62	6228.6	4.3	3.4	19.2	102	24615.8	2.9	10.9	171.3	142	4227.4	3.2	2.5	12.1	182	66271.1	3.5	38.2	470.1
23	5128.6	3	3.5	20	63	4609.8	3.3	3.8	16.2	103	16855	2.8	6.5	110.5	143	5619.3	4.6	3.4	15.1	183	70226.9	3.5	30.5	503.5
24	6598.4	4.7	3.1	19.1	64	7921.1	6.1	3.3	21.8	104	9930.6	2.9	5.3	57.5	144	6903.4	4.9	6.1	18.7	184	3986.9	1.3	2.2	18.5
25	5978	4.3	2.9	18.4	65	5035.4	3.4	3.2	15.9	105	19591.4	3	9.4	126.9	145	4895.7	3.7	2.6	12.7	185	3404.3	3	1.9	7.6
26	1518	0.5	1	7.7	66	5587.9	4.2	3.1	16	106	5550.1	3.6	2.6	20.6	146	4273.4	3.1	3.3	11.5	186	3972.5	2.1	3.1	14.6
27	5210.3	3.4	3.7	17.3	67	5665.2	4.3	3.2	17.9	107	5411.6	3.9	3.2	15.6	147	3265.3	2.5	2.3	8.8	187	1840.9	0.6	2	7
28	6733.5	5.1	2.4	16.9	68	6068.7	4.8	3.2	17.7	108	3903.6	3.9	3.9	12.9	148	5746.8	4.1	3.5	19.4	188	6568	5	3.9	18.4
29	5357.2	3.5	3.2	17.7	69	5901.5	4.1	3.2	18.9	109	5126.8	3.9	3.4	14.8	149	4300.8	2.6	3	13	189	5517.4	2.7	3.8	15.4
30	7537.8	5.7	6.1	21.4	70	5139.1	3.7	4.2	14.3	110	5495.3	3.5	3.7	17.8	150	5993.8	4.1	5.4	17.8	190	4561.3	3.3	3.1	12.8
31	6331.6	4.6	3.7	18.9	71	6096.1	4.4	2.9	18	111	2000	1.2	1.1	4.3	151	6012.4	3.5	5.8	17.9	191	6091.6	4.2	2.9	21.6
32	5841.5	4.2	3.5	15.1	72	6793.8	4.6	4.1	24.3	112	2854.7	1.9	0.9	8	152	3910.6	2	3.8	13.7	192	2094.2	0.8	1.7	8.7
33	4636.6	3.6	4.4	15.4	73	7775.1	5.5	5.1	23.9	113	2354.5	1.7	0.9	6.3	153	6213.3	1.4	11.4	16.9	193	6002.1	4.4	3.7	17.2
34	6296.9	4.6	3.1	19	74	6120.2	4.6	4.4	18	114	3923.2	2.9	1.4	12.4	154	3797.5	0.6	3.6	18.2	194	4799.2	3.1	4.2	16.2
35	6259.2	3.5	2.2	14.8	75	6483.7	5.4	4.4	16.8	115	6707	5.4	3.3	18.2	155	6327.2	3.5	4.2	25.4	195	4293.6	2.6	3.3	13.7
36	6456.5	3.6	5.4	21.8	76	7284.2	2.8	3	14.9	116	5560	3.6	2.6	20.6	156	4429.5	3.1	5.9	15.8	196	7659.7	2.5	14	17.6
37	7512.5	5.5	4.7	22.8	77	4144.7	2.8	2.4	13	117	5597.2	4.2	2.9	19.4	157	14920.2	4.8	7.5	79.8	197	2165.6	0.7	2.6	8.2
38	3708.3	2.5	1.9	13.8	78	3800.3	2.4	1.9	11.6	118	11261.6	4	6.3	55.5	158	11221.6	3.7	6.3	55.5	198	4609	0.4	6.7	22.7
39	9485.2	4.4	15.9	18.6	79	3774.1	2.3	2.3	10.5	119	5867.5	2.8	11.9	201.5	159	8280.7	0.7	20.9	16	199	4436.6	3	4.1	21.3
40	9060.6	1.4	6.5	52.5	80	4337.6	2.7	3.5	12.9	120	29351.5	2.8	11.9	201.5	160	6400.4	3.9	4.4	24.5	200	3291.4	0.4	3.8	16.8

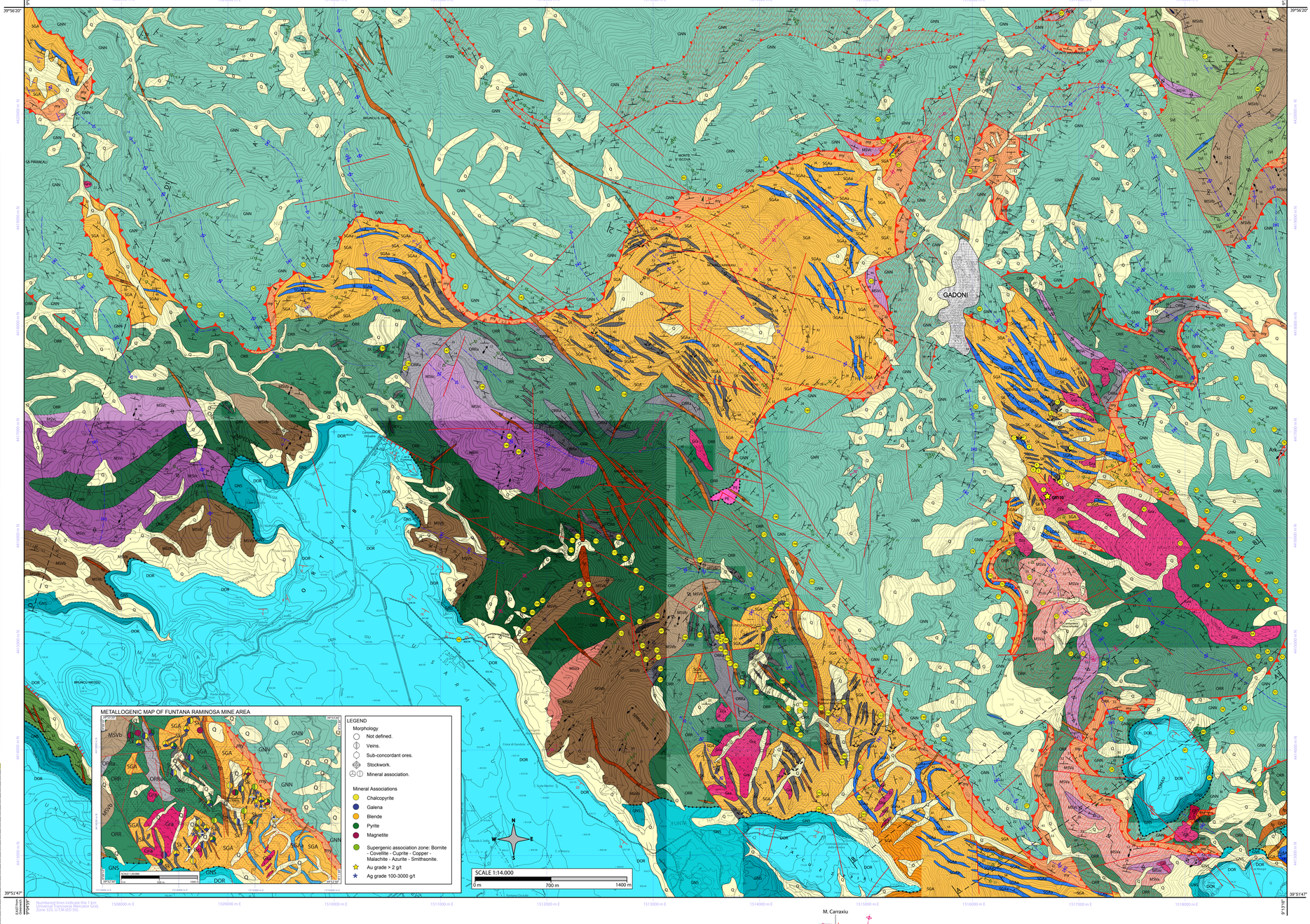
(FIGURE 3) STRATIGRAPHIC COLUMNS WITH SPECTROMETRIC FEATURES



(FIGURE 4) ISOTOPIC RELATIONSHIPS IN THE GADONI AREA

Formation	Average Values			Isotopic Ratios		
	K[%]	U[ppm]	Th[ppm]	U/Th	Th/k	U/K
DOR	0.2	1.75	1.4	1.25	7.00	8.75
GNS	0.5	1	7.7	0.13	15.40	2.00
fp	5.08	6.05	23.43	0.26	4.62	1.19
Gra	4.94	3.84	22.00	0.17	4.45	0.78
Ark	1.75	2.45	11.90	0.21	6.80	1.40
GNN	2.94	2.93	14.14	0.21	4.81	1.00
SGAa	0.84	2.66	7.05	0.38	8.42	3.18
SGA	2.23	14.11	18.14	0.78	8.14	6.33
ORR	3.9	8.78	109.92	0.08	28.18	2.25
ORRa	2.84	3.30	26.06	0.13	9.17	1.16
MSVa	4.93	4.40	18.47	0.24	3.75	0.89
MSVb	2.01	2.82	10.53	0.27	5.24	1.40
MSVc	3.87	3.53	15.21	0.23	3.93	0.91
SVI	2.52	4.00	13.13	0.30	5.21	1.59





CONCORDIA DIAGRAM WITH CONCORDANT AGE FROM THE GR110 SAMPLE

(FIGURE 5)