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SUPPLEMENTARY DATA

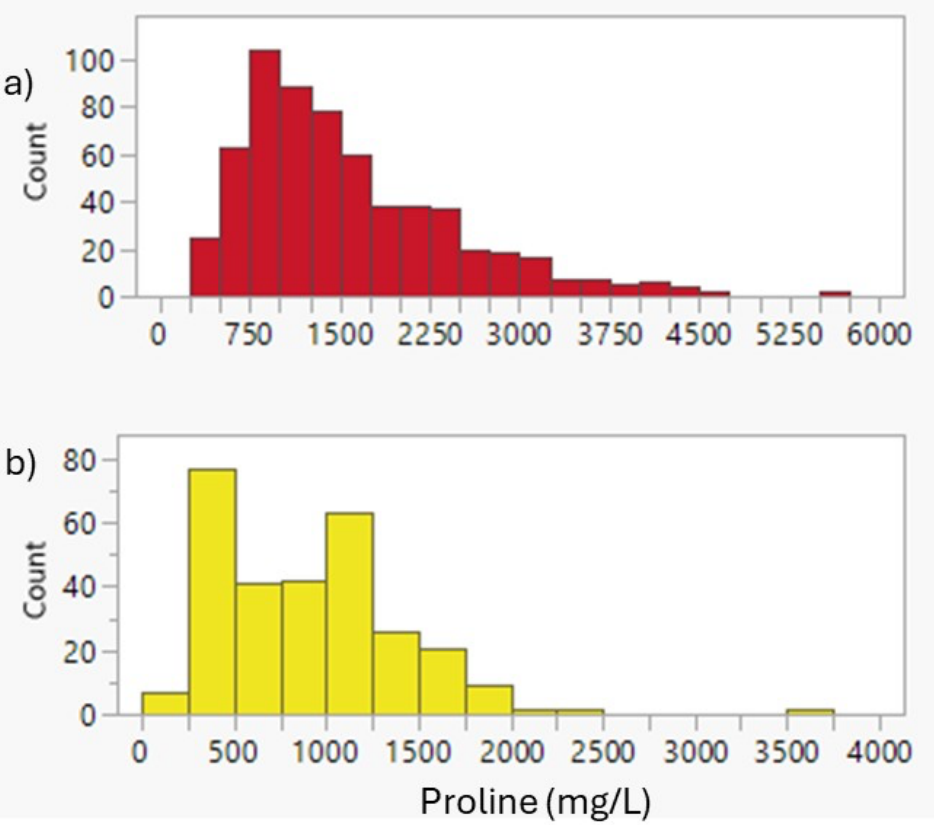


Figure S1. Histograms of proline in a) red wines and b) white wines surveyed.

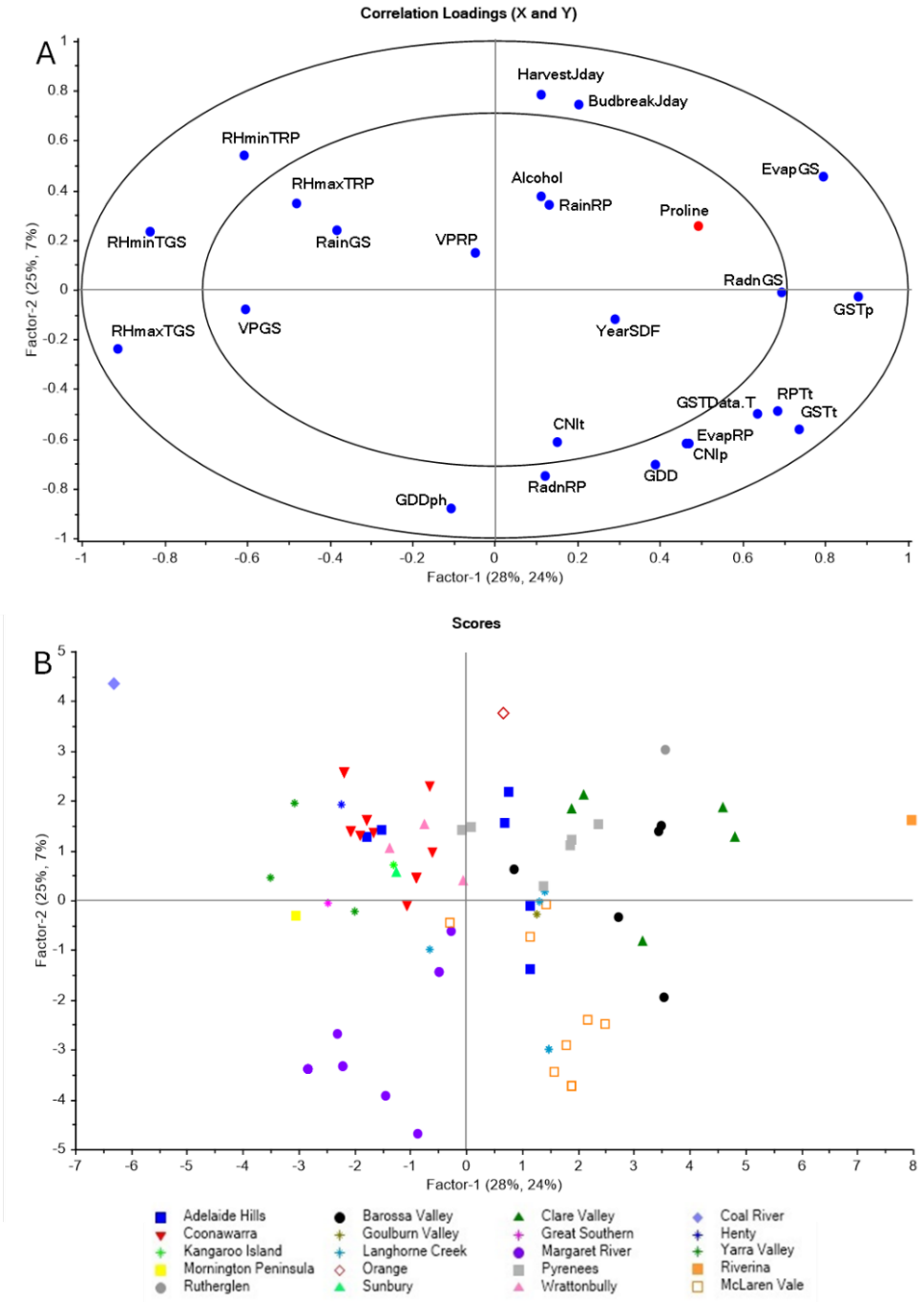


Figure S2. Partial Least Squares (PLS) Regression analysis of Cabernet-Sauvignon samples for the first two factors where 31 % of the variance in Y (proline) is explained by 53 % of the variance in X variables (coded as follows: RP, ripening period; GS, growing season; RH, relative humidity; GDD, growing degree days; GDDph, phenological growing degree days; GSTt, GS temperature; GSTp, phenological GS temperature; CNIt, cool night index; CNIp, phenological cool night index; RPTp, temperature during phenological RP; RainGS, total rainfall in GS; RainRP, total rainfall in RP; EvapGS, total evaporation in GS; EvapRP, total evaporation during RP; RadnRP, average solar radiation in RP; VPRP, vapour pressure during RP; RHmaxTRP, RH at maximum daily temperature; RHminTRP, RH at minimum daily temperature; Alcohol, wine alcohol content). A. Correlation loadings plot where the outer ellipse indicates 100 % explained variance and the inner ellipse indicates 50 % of explained variance; B. Scores plot showing the distribution of samples coded by sub-region for the sample of origin.

SUPPLEMENTARY DATA
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Table S1. Summary statistics for wine varieties, blends and styles ordered by mean proline concentration in mg/L (n = 918).

Wine	Observations	Min	Max	1st Quartile	Median	3rd Quartile	Mean	St dev (n-1)
Champagne Blend	2	310	362	323	336	349	336	37
Riesling	52	170	664	270	351	421	351	96
Assyrtiko	2	381	390	383	385	388	385	6
Gruner Veltliner	2	440	463	445	451	457	451	16
Semillon	7	314	713	395	503	543	486	134
Vermentino	8	350	846	383	410	578	493	169
Chenin Blanc	8	318	764	389	497	539	496	141
Dry White Blend	2	470	589	499	529	559	529	84
White Bordeaux Blend	10	384	846	437	484	673	553	159
Sauvignon Blanc	23	331	942	441	551	693	585	182
Marsanne	3	478	965	479	481	723	641	280
Pinot Grigio/Gris	24	377	1050	558	612	686	643	167
Pinot Noir Rosé	2	617	671	631	644	658	644	38
Gamay	7	420	958	508	671	774	659	200
Savagnin	2	537	843	613	690	767	690	217
Muscat	2	514	1044	647	779	912	779	375
Grenache	28	312	1408	562	751	1084	833	341
Gewürztraminer	2	730	953	786	842	897	842	157
Rosé Blend	3	784	971	785	787	879	847	107
Pinot Noir	94	366	1587	763	888	1022	892	236
Malbec	11	396	1915	551	790	1098	896	488
Barbera	6	304	1759	686	1116	1242	1020	519
Viognier	4	742	1252	852	1064	1242	1030	256
Red Rhone Blends	32	298	3136	691	1028	1274	1082	539
Tempranillo	13	497	1950	874	1082	1269	1092	386
Blaufränkisch	2	783	1513	965	1148	1330	1148	516
Graciano	2	612	1685	880	1148	1417	1148	758
Touriga National	2	1152	1240	1174	1196	1218	1196	63
Sciacarello	2	1183	1215	1191	1199	1207	1199	23
Chardonnay	138	508	2101	1005	1142	1422	1217	291
Shiraz/Syrah	198	403	3262	943	1288	1585	1323	493
Mataro/Mourvèdre	4	1073	1653	1117	1306	1523	1334	278
Garganega	2	990	1794	1191	1392	1593	1392	569
Montepulciano	12	722	2037	1291	1488	1691	1497	383

Lagrein	2	1394	1613	1449	1504	1559	1504	155
Nero d'Avola	7	528	2349	1484	1556	1861	1589	573
Cabernet Franc	6	786	2133	1475	2038	2060	1725	557
Sangiovese	19	771	3161	1246	1890	2179	1754	617
Fiano	7	1121	3510	1280	1434	1970	1795	874
Durif/Petite Sirah	5	1279	2650	1292	1616	2450	1857	651
Nebbiolo	8	1065	3033	1142	1610	2825	1908	874
Cabernet Sauvignon/Shiraz Blend	12	930	2760	1584	2045	2165	1912	542
Dry Red Blend	8	390	2682	1681	2094	2439	1923	749
Cabernet Sauvignon	101	1191	5546	2146	2472	3062	2629	766
Red Bordeaux Blend	19	1232	4436	1691	2383	3688	2630	1086
Merlot	11	1288	3883	2248	2737	3125	2709	735
Zinfandel	2	1767	3950	2313	2858	3404	2858	1544

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Table S2. List of non-Australian wine samples and their origin, price and proline concentration.

Country	Type	Vintage	Variety	Region	Sub-region	Price (AUD)	Proline (mg/L)
Armenia	Red	2019	Areni	Vayots Dzor		60	737
Austria	Red	2018	Blaufränkisch	Burgenland		42	783
Austria	White	2020	Riesling	Wachau		150	536
France	Sparkling	NV	France	Champagne		80	310
France	Sparkling	2016	France	Champagne		70	362
France	Red	2015	Cabernet Sauvignon	Bordeaux	Pauillac	156	1855
France	Red	2017	Pinot Noir	Burgandy	Cote de D'Or	230	589
France	Red	2019	Pinot Noir	Burgandy	Côte de Nuits	130	970
France	Red	2016	Pinot Noir	Burgundy	Pommard	155	486
France	Red	2017	Pinot Noir	Burgundy	Vosne-Romanée	220	610
France	Red	2019	Red Bordeaux Blend	Bordeaux	Fronsac	24	1436
France	Red	2015	Red Bordeaux Blend	Bordeaux	Margaux	120	1682
France	Red	2015	Red Bordeaux Blend	Bordeaux	Pauillac	120	1905
France	Red	2021	Red Rhone Blends	Provence	Bandol	80	298
France	Red	2018	Red Rhone Blends	Provence	Bandol	80	694
France	Red	2006	Red Rhone Blends	Rhone Valley	Côtes du Rhône	150	969
France	Red	2011	Red Rhone Blends	Rhone Valley	Chateauneuf-du-Pape	110	1276

France	Red	2019	Red Rhone Blends	Rhone Valley	Côtes du Rhône	21	1219
France	Red	2017	Shiraz/Syrah	Northern Rhone	Rhone Valley	150	1273
France	Red	2017	Shiraz/Syrah	Rhone Valley	Côtes du Rhône	250	1521
France	Red	2019	Shiraz/Syrah	Rhone Valley	Crozes-Hermitage	70	1492
France	White	2019	Chardonnay	Burgandy		250	1136
France	White	2020	Chardonnay	Burgandy	Pouilly-Fuisse	150	959
France	White	2017	Chardonnay	Burgundy	Meursault	190	753
France	White	1990	Chenin Blanc	Loire Valley		150	496
France	White	2016	Riesling	Alsace		44	292
France	White	2020	Riesling	Alsace	Alsace	45	219
France	White	2021	Sauvignon Blanc	Loire Valley	Sancerre	60	493
France	White	2012	Savagnin	Jura		135	843
Germany	White	2020	Riesling	Mosel		105	202
Greece	Red	2019	Xinomavro	Macedonia	Naoussa	36	1963
India	White	2019	Sauvignon Blanc	Western India	Sahyadri Ranges Nashik	15	932
Italy	Red	2020	Barbera	Piedmont	Alba	28	580
Italy	Red	2019	Barbera	Piedmont	Langhe	45	304
Italy	Red	2016	Cabernet Sauvignon	Tuscany	Bolgheri	380	1542

Italy	Red	2018	Corvina Blend	Veneto	Amarone della Valpolicella	130	2318
Italy	Red	2016	Lagrein	Trentino-Alto Adige	Alto Adige - Südtirol	50	1394
Italy	Red	2019	Lagrein	Trentino-Alto Adige	Alto Adige - Südtirol	20	1613
Italy	Red	2004	Nebbiolo	Piedmont	Piedmont	70	1065
Italy	Red	2004	Nebbiolo	Piedmont	Barolo	90	1223
Italy	Red	2018	Nebbiolo	Piedmont	Langhe	55	1144
Italy	Red	2020	Nebbiolo	Sicily	Etna	135	1135
Italy	Red	2019	Nerello Mascalese	Sicily	Etna	49	897
Italy	Red	2018	Sangiovese	Tuscany		200	1155
Italy	Red	2016	Sangiovese	Tuscany	Brunello di Montalcino	120	1314
Italy	Red	2018	Sangiovese	Tuscany	Rosso di Montalcino	62	1025
Italy	White	2021	Carricante	Sicily	Etna	68	729
Italy	White	2018	Garganega	Veneto	Soave Classico	75	1794
Italy	White	2021	Garganega	Veneto	Soave Classico	40	990
Italy	White	2021	Pinot Grigio/Gris	Alto Adige	Trentino	30	1001
New Zealand	Red	2021	Merlot	North Island	Hawkes Bay	30	1288
New Zealand	Red	2016	Pinot Noir	South Island	Central Otago	85	532

New Zealand	Red	2021	Pinot Noir	South Island	Bannockburn	64	867
New Zealand	Red	2018	Pinot Noir	South Island	Bannockburn	80	1097
New Zealand	Red	2021	Pinot Noir	South Island	Bannockburn	80	847
New Zealand	Red	2021	Pinot Noir	South Island	Central Otago	75	838
New Zealand	Red	2018	Pinot Noir	South Island	Central Otago	78	905
New Zealand	Red	2018	Pinot Noir	South Island	Central Otago	90	1133
New Zealand	Red	2016	Red Bordeaux Blend	North Island	Hawkes Bay	30	1798
New Zealand	Red	2016	Shiraz/Syrah	South Island	Bendigo	63	1193
New Zealand	Red	2016	Shiraz/Syrah	South Island	Bendigo	70	1192
New Zealand	Rosé	2022	Pinot Noir	South Island	Central Otago	33	671
New Zealand	White	2021	Chardonnay	South Island	Marlborough	60	952
New Zealand	White	2021	Chardonnay	South Island	Bannockburn	50	929
New Zealand	White	2021	Chardonnay	South Island	Central Otago	90	970

New Zealand	White	2022	Sauvignon Blanc	South Island	Marlborough	35	438
New Zealand	White	2022	Sauvignon Blanc	South Island	Marlborough	14	517
South Africa	Red	2016	Cabernet Sauvignon	Franschhoek	Franschhoek	110	2759
Spain	Red	2020	Grenache	Aragon	Campo de Borja	13	1312
Spain	Red	2018	Rhone blend	Catalunya	Priorat	55	480
Spain	Red	2018	Syrah/Cabernet Sauvignon/Grenache/Carignan	Catalunya	Priorat	100	974
Spain	Red	2010	Tempranillo	La Rioja	La Rioja Alta	90	1271
Spain	Red	2017	Tempranillo	Rioja		20	918
Spain	Red	2017	Tempranillo	Rioja		210	1082
Spain	Red	2018	Tempranillo	Rioja	Lanciego de Alava	30	788
USA	Red	2020	Pinot Noir	California		32	433
USA	Red	2020	Shiraz/Syrah	California	Santa Maria Valley	92	840

Table S3. Weighted regression coefficients for Factors 1 to 4 for the partial least squares (PLS) regression model developed for Cabernet-Sauvignon wine proline concentration as predicted by significant sub-regional climatic variables together with alcohol concentration.

Variable	Association with Y (proline) positive (+) or negative (-)	Factor 1	Factor 2	Factor 3	Factor 4
Alcohol	+	0.05	0.12	0.27	0.32
RadnGS	+	0.07	0.11	0.19	0.17
EvapGS	+	0.08	0.12	0.15	0.16
EvapRP	+	0.04	0.04	0.11	0.14
budBreakJday	+	0.04	0.08	0.09	0.10
RPTp	+	0.04	0.03	0.03	0.07
GSTData.Tmean	+	0.04	0.04	0.06	0.07
VPRP	+	0.00	0.01	0.02	0.06
RainRP	+	0.02	0.03	0.02	0.05
harvestJday	+	0.02	0.05	0.01	0.02
CNIp	-	0.00	-0.06	-0.15	-0.17
VPGS	-	-0.06	-0.08	-0.11	-0.10
RHminTGS	-	-0.06	-0.05	-0.04	-0.07
RHminTRP	-	-0.03	-0.01	0.00	-0.05
GDDph	-	-0.03	-0.06	-0.03	-0.04
RHmaxTGS	-	-0.08	-0.09	-0.06	-0.01